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WHEAT-MANURING EXPERIMENTS IN THE SOUTH ISLAND.

SUMMARY OF ELEVEN SEASONS' RESEARCH.

Fields Division.

WHEAT-MANURING experiments have been conducted by the Fields Division of the Department of Agriculture over the past eleven seasons, and during that time one hundred and eighty trials have been harvested. The detailed results of these have been published at various times in the *Journal of Agriculture* (see references at the end of this article). In the *Journal* for April, 1929(7),* the results up to and including the 1928–29 season were summarized and tentative recommendations made.

Whereas the experiments covered by that summary were confined to Canterbury and North Otago, subsequently a few of the trials were extended to Marlborough(11, 12), Central Otago(11), and Southland(13), so that a wide range of soil types has been covered and a variety of seasons experienced during the eleven years' research completed to date. There is therefore a large amount of evidence on which to base recommendations to farmers regarding the manuring of wheat, and it is considered that this is an opportune time to review the work that has been done and to analyse the results secured.

Problems under Investigation.

The earliest experiments (1923–24 to 1928–29) investigated, amongst other things, the relative merits of superphosphate, basic super, ephos, and Nauru phosphates, with the results indicated below under the heading of "Superphosphate compared with other Phosphates."

During the seasons 1929–30 to 1931–32 the effect of increasing the quantity of superphosphate from 1 cwt. to 2 cwt. per acre was investigated.

Preliminary work on the use of dried blood gave indications that more available forms of nitrogen might be of considerable benefit. Consequently, more concentrated and quicker-acting nitrogenous fertilizers, such as nitrate of soda and sulphate of ammonia, were later put under trial, and for several seasons these were included in the general programme of experiments, which investigated not only the relative merits of each, but also different quantities and times of application.

* Figures in brackets indicate references at the end of this article.

Concurrently with this general investigation into the use of superphosphate and nitrogen, potash as an adjunct to super and to super plus nitrogen was also put under trial.

Also, following the conclusions from a grassland response-to-manure survey of Canterbury, which indicated a general response to liming, and because of a practice being adopted by a few farmers, carbonate of lime as an addition to super was included in the programme.

Technique.—In the *Journal* for July, 1926(15), a brief description of the methods employed in carrying out wheat-manuring trials was given. Slight modifications have been introduced from time to time, and these have been mentioned in the various reports presented in the *Journal*. The more up-to-date equipment now in use is illustrated in the *Journal* for April, 1929(7). From ten to twelve replications of each treatment were sown in most of the experiments, while in trials necessitating a greater degree of precision as many as twenty-four replications were used.

All results were examined statistically, "Student's" method being used generally.

Summary of Results.

SUPERPHOSPHATE.

Superphosphate compared with other Phosphates.

In twenty-nine trials in which superphosphate was compared with basic super,* each at 1 cwt. per acre, no case was recorded in which basic super was superior to super. The average results of these trials showed—

	Bushels per Acre.
Increase of super over no manure	.. 5·5
Increase of basic super over no manure ..	.. 4·3
Difference in favour of super ..	.. 1·2

The superiority of super over basic super is significant.

Seventeen trials compared superphosphate with ephos and Nauru phosphates with the following average results:

	Bushels per Acre.
Increase of super over no manure	.. 5·6
Increase of ephos over no manure ..	.. 2·0
Increase of Nauru over no manure ..	.. 1·5

The marked superiority of super is obvious and was consistent throughout all trials in which a significant phosphate response occurred.

Increased Yields as a Result of using Superphosphate at 1 Cwt. per Acre.

During the eleven seasons under review 124 experiments have been carried out in which 1 cwt. super per acre has been compared with no manure. The average increase due to the use of super in these trials was 4·1 bushels per acre.

* So-called "commercial basic super" has varied in its composition. At the time these trials were conducted the material used was probably a mixture of 60 parts superphosphate, 20 parts Nauru phosphate, and 20 parts carbonate of lime. It is probable that the present-day basic super is merely a mixture of about 90 parts of superphosphate with 10 parts of lime (burnt or carbonate).

Only sixteen experiments have failed to give statistically significant increases, while the remaining 108 have shown significant increases of from 1 bushel to 13·8 bushels per acre. In every experiment the difference, however small, has been in favour of superphosphate.

The number of these experiments in each season, together with the average increase due to super in each, is as follows :—

Table 1.—Showing Average Response to Super 1 Cwt. in each of Eleven Seasons.

Season.	Number of Experiments.	Average Increase due to Super 1 Cwt. (Bushels per Acre.)	Range of Increases. (Bushels per Acre.)
1923–24	2	4·7	0·4 to 9·0
1924–25	7	6·0	0·2 to 10·8
1925–26	4	2·5	1·0 to 4·4
1926–27	5	2·9	1·0 to 5·0
1927–28	6	3·9	0·4 to 8·1
1928–29	12	6·1	1·2 to 13·8
1929–30	32	3·8	0·4 to 7·0
1930–31	26	3·2	0·4 to 7·6
1931–32	19	5·2	2·1 to 12·8
1932–33	3	3·4	2·2 to 7·6
1933–34	8	2·4	0·4 to 6·8
Average of all trials	124	4·1	0·2 to 13·8

Returns from Use of 1 Cwt. Superphosphate.

During the eleven seasons under review the prices of wheat and superphosphate have fluctuated to a certain extent, but more or less proportionately, so that in practically each season it could be said, broadly speaking, that an extra return of 1 bushel of wheat would pay for an application of 1 cwt. of super.

As only twelve experiments out of 124 have given increases less than 1 bushel from the use of 1 cwt. of super it is obvious that the latter is a profitable and safe investment.

Effect of Prior Crop on Phosphate Response in Wheat Crop.

That the effect of superphosphate on the wheat crop is not influenced by the prior crop to an extent which need be considered in practice is shown by the following analysis :—

Table 2.—Showing Relationship between Response to Superphosphate and Prior Crop in 116 Trials.

Crop preceding Wheat Experiment.	Number of Experiments.	Average Increase due to Super 1 Cwt. (Bushels per Acre.)	Range of Increases. (Bushels per Acre.)
Grass	32	5·1	0·9 to 13·8
Wheat, oats, or barley ..	36	3·4	0·4 to 9·0
Potatoes	14	4·8	0·5 to 10·8
Peas, vetches, or lupins ..	12	3·2	0·4 to 8·1
Rape or turnips ..	22	4·6	1·7 to 10·3

From the above it will be observed that there is a tendency for the effect of super to be most pronounced when the prior crop is grass.

Effect of increasing the Quantity of Super from 1 Cwt. to 2 Cwt.

A total of thirty-eight experiments has been carried out in which super 2 cwt. has been compared with 1 cwt. The average superiority of the larger quantity over the smaller has been 0·2 bushels per acre. Since only five of these experiments have shown significant increases in favour of super 2 cwt. and four others have actually given significant decreases when the larger quantity has been used, the use of more than 1 cwt. of super for wheat cannot be recommended in general. The districts in which the 2 cwt. was superior to 1 cwt. were—(*a*) Tua Marina and Renwicktown, Marlborough(11 and 12); (*b*) Rangiora(13); (*c*) Springbank, North Canterbury(11).

Potash.

Summary of Effect from 1 Cwt. of Muriate of Potash added to Super 1 Cwt.

Since the 1927–28 season there have been forty trials in which 1 cwt. of muriate of potash added to super was compared with super alone. Of these, seven experiments showed significant increases from the use of potash, but the increase was sufficient to meet the cost of the fertilizer in one experiment only. In nine experiments significant depressions in yield resulted.

The average yield of super plus potash in the forty trials is 0·5 bushels *lower* than the average of the plots treated with super only.

In the above trials plots sown with super plus potash and afterwards top-dressed with nitrate of soda yielded on an average 0·8 bushels *less* than those receiving super plus nitrate of soda.

In these experiments the muriate of potash was mixed with the super and applied with the seed, resulting in a number of cases in delayed, and in a few cases in reduced, germination.

Nitrogen.

In recent years much work has been done on the effect of different nitrogenous fertilizers on the wheat crop. Following the success which attended the top-dressing of wheat crops with nitrate of soda in the 1925–26, 1926–27, and 1927–28 seasons, numerous experiments were carried out to compare the effect of sulphate of ammonia with that of nitrate of soda, and the effect of increasing the quantities of both. Several experiments were also conducted to determine the best months of application not only of nitrate of soda and sulphate of ammonia, but also of other nitrogenous fertilizers—viz., urea, calcium cyanamide, and calnitro. The results of a few experiments with nitro-phosphatic fertilizers are also discussed below.

General Effect of Nitrate of Soda over Period of Eight Seasons.

Altogether 129 experiments have been completed in which nitrate of soda at 1 cwt. per acre top-dressed on plots sown with super can be compared with plots not top-dressed.

The results during each of eight seasons are shown in the following table :—

Table 3.—Showing Average Response to Nitrate of Soda 1 Cwt. in each of Eight Seasons.

Season.	Number of Experiments.	Average Increase due to the Use of Nitrate of Soda 1 Cwt. top-dressed. (Bushels per Acre.)	Range of Differences. (Bushels per Acre.)
1925–26 ..	1*	5·9	..
1926–27 ..	3	3·1	+1·0 to 5·2
1927–28 ..	7	5·3	−0·8 to +11·1
1928–29 ..	14	4·6	−0·4 to +10·8
1929–30 ..	33	4·4	−1·7 to +10·7
1930–31† ..	30‡	2·9	−0·9 to +6·4
1931–32† ..	21‡	0·8	−2·7 to +5·2
1932–33 ..	20‡	2·2	−0·6 to +9·5
Average ..	129	3·2	..

* Nitrate of soda at 93 lb. † Unusually dry seasons. ‡ Includes thirteen experiments in the three seasons in which nitrate of soda at 149 lb. was used.

It will be seen from Table 3 that there is a considerable variation in the average response to nitrate of soda from season to season, and that the results in the last three seasons were considerably lower than in the three preceding ones. Moreover, the variation in the magnitude of effect has been considerable, being as high as 11·1 bushels in one experiment and as low as −2·7 bushels.

Twenty-three experiments show lower yields from super plus nitrate of soda than from super only, although in only two of these is the reduction statistically significant.

Effect of Prior Crop on Response of Wheat Crop to Nitrogen.

An analysis of the effect of nitrate of soda in relation to the prior crop is presented in Table 4 :—

Table 4.—Showing Relationship between Response to Nitrate of Soda 1 Cwt. and Prior Crop.

Crop preceding Wheat Experiment.	Number of Experiments.	Average Increase due to Nitrate of Soda.	Number of Experiments in which Response was Greater than the Average of 3·2 Bushels.
Grass	32	2·8	14
Wheat, oats, or barley ..	39	4·3	28
Rape or turnips ..	31	2·1	8
Peas, vetches, or lupins ..	10	3·5	4
Potatoes	8	3·9	4
Other crops	9	3·6	5
Total ..	129	..	61
Average of all trials ..	..	3·2	..

Table 4 indicates that generally wheat following a cereal has responded to the top-dressing of nitrate of soda better than where wheat follows grass or rape and turnips, and that the effect as indicated by the last column has been more consistent. The number of trials on wheat following the other crops mentioned is rather small to warrant comment.

It is obvious that the average effect on 1 cwt. of nitrate of soda is not sufficient to warrant a recommendation for its general use. At the present time wheat is worth about 3s. 3d.* (*i.e.*, selling-price less cost per bushel of threshing, bags, cartage, railage, commission, &c.), and nitrate of soda costs about 13s. 6d. per hundredweight ex store. Consequently at least 4 bushels of wheat are required to meet the cost of 1 cwt. of nitrate of soda. Even if sulphate of ammonia, 1 cwt. of which would appear to be slightly more effective than 1 cwt. of nitrate of soda, is used, the average increase of 3·2 bushels per acre barely meets the cost of 1 cwt. of sulphate of ammonia, which is in the vicinity of 11s. per hundredweight ex store.

It must be borne in mind that in the trials recorded here nitrogen was used irrespective of the prior crop or whether the crop showed symptoms of nitrogen deficiency in the spring. The fact that the greatest average effect from nitrogen was on crops following cereals suggests that under such conditions, especially if crops show symptoms of nitrogen starvation, the use of 1 cwt. of a soluble nitrogenous fertilizer may be profitable. Future work with nitrogen must be along the lines of determining its effect on those crops which appear in need of it in the early spring.

Comparison between Nitrate of Soda and Sulphate of Ammonia.

Thirty-two experiments have been carried out comparing nitrate of soda at 1 cwt. with sulphate of ammonia 1 cwt. The average superiority in favour of the latter has been 0·5 bushels per acre.

Since sulphate of ammonia has been at a consistently lower price during the past few seasons than nitrate of soda, and from the fact that on the average it has outyielded the latter by 0·5 bushels per acre, sulphate of ammonia would appear to be the better proposition where nitrogen is being used.

There have been twenty-four experiments in which nitrate of soda at 1½ cwt. could be compared with the same quantity of sulphate of ammonia, and in these the average superiority of the latter is 0·9 bushels per acre.

Effect of increasing the Quantity of Nitrogen.

In twenty-four experiments in which nitrate of soda at 1 cwt. and 1½ cwt. respectively was applied, the average superiority of the larger quantity is 0·4 bushels per acre.

Sulphate of ammonia at 1 cwt. could be compared with 1½ cwt. in thirty-two experiments. In these the average superiority of the larger quantity was 1·1 bushels per acre.

In these experiments the nitrate of soda was top-dressed in late September, while the sulphate of ammonia was top-dressed about a

* This is based on the Wheat Pool price of 3s. 6d., plus a probable bonus of 9d. a bushel.

month earlier than this. Such times of application were regarded as being the most suitable from indications given in carefully planned trials on this aspect of nitrogenous top-dressing.

Increasing the quantity of nitrogen from 1 cwt. to 1½ cwt. has not been accompanied by increased yields commensurate with the additional cost.

Times of Application of Sulphate of Ammonia and Nitrate of Soda.

In thirteen trials conducted over four seasons(9, 10, 13, and 14) the effect of time of application of sulphate of ammonia and nitrate of soda as adjuncts to 1 cwt. of super per acre has been investigated. Application of sulphate of ammonia at 1 cwt. in August and late September, and dressings of nitrate of soda at 149 lb. in August, September, and October respectively have been made in all thirteen experiments, with the following results :—

Table 5.—Showing Average Increase due to Sulphate of Ammonia 1 Cwt. per Acre and Nitrate of Soda 149 lb. per Acre over no Nitrogen.*

Treatment.	Time of Application.	Average Increase over No Nitrogen. (Bushels per Acre.)
Sulphate of ammonia 1 cwt. ..	August	3·0
	September ..	3·0
Nitrate of soda, 149 lb. ..	August	3·5
	September ..	4·4
	October	4·6

* Containing quantity of nitrogen equivalent to that in 1 cwt. sulphate of ammonia.

In four trials late October applications of sulphate of ammonia have been made, but the average increase over no nitrogen in the case of this treatment was only 3·1 bushels as compared with 4·3 bushels from September dressings of sulphate of ammonia in corresponding trials.

In the 1931–32 season three experiments(13) and in the 1932–33 season eighteen experiments(14) were conducted in which 1 cwt. of sulphate per acre mixed with superphosphate and sown with the seed in the winter was compared with spring applications of sulphate of ammonia to plots sown with super in the winter. The results were as follows :—

	Average Increase over No Nitrogen.	
	Sulphate of Ammonia with Seed.	Sulphate of Ammonia top-dressed in Spring.
1931–32 : Three experiments ..	3·4	2·3
1932–33 : Eighteen experiments ..	0·9	2·5

The very poor results from the application with the seed in 1932–33 are probably due in part to its harmful effect on germination which was apparent in a number of trials.

From the evidence put forward it is apparent that the best time to apply sulphate of ammonia is either in August or September, while nitrate of soda is best applied from about the middle of September to the middle of October. The risk of serious germination injury is against the use of sulphate of ammonia at seeding, at least, when it is drilled in with superphosphate in contact with the seed.

Other Nitrogenous Fertilizers.

Three other nitrogenous fertilizers—urea, calcium cyanamide, and calnitro—have been tried out against nitrate of soda or sulphate of ammonia in two experiments. These were included in the earlier trials(9 and 10) investigating time of application of nitrogen. Equivalent quantities of nitrogen and/or phosphate were applied in each case. The results, however, indicate that these forms of nitrogen are slightly inferior to nitrate of soda top-dressed in September on wheat which has been sown with super, although in the 1930–31 season all were superior to sulphate of ammonia when applied in August, but not significantly so. Results in both seasons indicate that urea, calcium cyanamide, and calnitro give better results applied in August than when applied in September or October.

Effect of Super (with Seed) plus Sulphate of Ammonia (top-dressed) compared with Concentrated Fertilizers containing Equivalent Quantities of Phosphate and Nitrogen.

Two experiments were carried out in the 1925–26 and 1926–27 seasons(3 and 5) in which Ammo-Phos* (16·5 per cent. N. and 20 per cent. P_2O_5) at 100 lb. per acre was compared with equivalent quantities of phosphate and nitrogen in super plus sulphate of ammonia. Ammo-Phos was significantly lower in yield in 1925–26 by 0·8 bushels per acre. In 1926–27 it was superior, but not significantly so, by 0·4 bushel.

In the 1932–33 season MAP2,† containing 18 per cent. nitrogen and 18 per cent. phosphoric acid, at 127 lb. per acre at seeding, was compared with super 1 cwt. (at seeding) plus sulphate of ammonia 1 cwt. (top-dressed). The yield of the former was 57·5 bushels per acre, while the latter yielded 56·8 bushels. The difference between them was not significant.

Leunaphos‡ containing 20 per cent. nitrogen and 20 per cent. phosphoric anhydride was tried out in eight experiments in the 1930–31 season. It was used to supply extra phosphate to plots sown with 1 cwt. of super, and as a nitrogen addition. It was applied as a spring top-dressing in September or October about a month later than sulphate of ammonia applications. In most cases it was inferior in effect to the sulphate of ammonia in spite of the phosphate which it supplied. It is probable that the lateness of its application detracted from its effect.

Effect of Carbonate of Lime as an Addition to Super.

The use of carbonate of lime 2 cwt. per acre as an addition to super at 1 cwt. was investigated in thirty-seven experiments. Of these only nine showed increases of from 1½ bushels to 2½ bushels of wheat. Generally speaking, these increases occurred on soils highly deficient in lime, although other soils equally deficient have not given responses. The use of lime as an addition to super sown with wheat cannot therefore be recommended generally, although in some places its use has been shown to have some effect.

* An American fertilizer. † An English fertilizer. ‡ A German fertilizer.

SUMMARY.

1. The results of 180 experiments on the manuring of wheat conducted over the past eleven seasons have been discussed and analysed.

2. Nearly all trials were carried out on a co-operative basis on private farms, from ten to twenty-four replications of each treatment being sown.

3. The results of all experiments were submitted to statistical examination, "Student's" method being used generally.

4. The chief objects of the trials were:—

(*a*) To compare various phosphates with no manure:
(*b*) To determine the effect of increasing the quantity of super from 1 cwt. to 2 cwt. per acre;
(*c*) To determine the effect of using potash as an adjunct to super and super plus nitrogen:
(*d*) To determine the effect of using nitrogen as an adjunct to super and super plus potash:
(*e*) To compare the effects of different forms of nitrogenous fertilizers, and different times and quantities of application:
(*f*) Comparison of lime plus super with super.

5. During the eleven seasons under review 124 experiments have been carried out in which 1 cwt. super has been compared with no manure. The average increase due to the use of super in these trials was 4·1 bushels.

The use of 1 cwt. of superphosphate per acre at time of sowing the wheat crop, irrespective of the previous crop, is strongly recommended.

6. The average superiority of super at 2 cwt. per acre over 1 cwt. in thirty-eight experiments was 0·2 bushels per acre.

The use of a greater quantity than 1 cwt. super cannot in general be recommended with the wheat crop.

7. Phosphates such as basic super, ephos, and Nauru phosphate have proved inferior to superphosphate.

8. The average yield of super plus muriate of potash in the forty trials in which it was compared with super alone was 0·5 bushels per acre *lower* than the super plots. A complete manure containing muriate of potash was 0·8 bushels lower yielding on the average than phosphate plus nitrogen.

9. The average increase due to the top-dressing of 1 cwt. nitrate of soda in 129 experiments was 3·2 bushels per acre. At present prices such an increase would not cover the cost of the fertilizer.

10. Wheat following a cereal crop generally responded better to applications of nitrate of soda than where wheat followed grass, rape, or turnips.

11. In general, the effect of sulphate of ammonia was slightly superior to that of nitrate of soda when equal weights per acre of the fertilizers were used.

12. The effect of increasing the quantities of sulphate of ammonia and nitrate of soda respectively from 1 cwt. to 1½ cwt. was for the additional ½ cwt. to increase the yield over that from 1 cwt. by 1·1 bushels per acre in the case of the former and 0·4 bushels in the case of nitrate of soda.

13. From the results of thirteen trials conducted on times of application of nitrogen it appears that the best time to apply sulphate of ammonia is in August or September, while September and October are the most favourable months for nitrate of soda applications. The use of sulphate of ammonia with super at seeding is not recommended.

14. The effect of other nitrogenous fertilizers is discussed.

15. The results of thirty-seven experiments in which the effect of carbonate of lime added to super was under trial indicates that the use of lime cannot be recommended generally, although it has caused small increases in yield in some cases.

REFERENCES.

The results of all experiments on which this article is based will be found in the *Journals* indicated below :—

(1) Wheat-manurial Tests in Canterbury. Vol. 30 ; April, 1925, p. 229.
(2) Wheat-manurial Experiments in Canterbury. Vol. 32 ; August, 1926, p. 106.
(3) Ashburton Experimental Farm : Work of the 1925–26 Season. Vol. 33 ; November, 1926, p. 316.
(4) Wheat-manuring Experiments in Canterbury, 1926–27. Vol. 35 ; September, 1927, p. 182.
(5) —— 1926–27. Vol. 35 ; October, 1927, p. 251.
(6) —— 1927–28. Vol. 36 ; May, 1928, p. 339.
(7) —— Summary of Six Seasons' Research. Vol. 38 ; April, 1929, p. 221.
(8) —— 1928–29. Vol. 38 ; May, 1929, p. 337.
(9) Nitrogen Top-dressing of Wheat : Season 1929–30. Vol. 42 ; March, 1931, p. 185.
(10) —— Season 1930–31. Vol. 43 ; July, 1931, p. 46.
(11) Wheat-manuring Experiments in the South Island : Season 1929–30. Vol. 41 ; July, 1930, p. 29.
(12) —— Season 1930–31. Vol. 42 ; May, 1931, p. 311.
(13) —— Season 1931–32. Vol. 45 ; August, 1932, p. 80.
(14) —— Season 1932–33. Vol. 47 ; September, 1933, p. 166.
(15) Field Experimental Methods. Vol. 33 ; July, 1926, p. 6.

—A. W. Hudson, Crop Experimentalist.
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Contamination of Milk through Teat Canals.—It quite frequently happens that cows wade in pools of filthy water or lie down in soil contaminated with objectionable germs. In this way the outside of the udder and teats become heavily infected so as to necessitate very thorough washing. At the tip of the teat is a short canal about ½ in. long, in which, after milking, a little milk always remains. It is possible for objectionable germs from water or manure on the udder to develop in the portion of dried milk at the end of the teat, and so infect the milk in this short canal. All the milk drawn from the udder must pass through this heavily infected canal. This is the explanation for the trouble which has occurred from time to time on farms where machines and utensils are kept in a thoroughly clean and sanitary condition. After bad second-grade curds have been obtained the trouble has sometimes been traced to one or more cows which have such infection in their teats. To avoid trouble of this kind cows should be prevented from wading in stagnant water and kept out of badly fouled night paddocks. In the best dairies the practice is adopted of discarding the first two or three squirts from each teat so as to prevent the bulk milk from being heavily infected from the teat canal.—*Wallaceville Dairy Laboratory Note.*

HAIRY FIBRES OF THE ROMNEY SHEEP.

IV. FIBRE TYPE ARRAYS AND HAIRINESS.

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INTRODUCTION.

THE purpose of this article is to put forward the main ideas that have emerged in the work on the coat of the Romney lamb when the fibre types are considered not separately, but as collections or arrays. Our knowledge of fibre type arrays bears both directly and indirectly on the problem of reducing hairiness. This work was undertaken, however, primarily on general principle. From work on smaller mammals it was known what sort of facts ought to be discovered about the kinds of fibres that make up the coat. It was believed that if such facts were found out they would prove, in some way or other, useful to wool-growing.

At the outset one probable application was much in mind, in that it was anticipated that we should learn to detect with greater certainty at an early age which animals will prove desirable, and which undesirable, from the point of view of hairiness. It was expected that we should become able, relatively early in the life of the lamb, to judge of the hairiness of the first fleece, and to foretell the hairiness of future fleeces. It has been shown in earlier articles* how these hopes are being realized for hairiness of both the kemp and the non-kemp groups.

Further progress in this direction in regard to the fibres grown later in the follicles from which halo-hairs are shed is to be reported briefly later in this article. It is not now the object to record these facts about succession in kemp follicles in more than a preliminary way. Essential facts will be recorded about conditions associated with differences between individual animals in the fibres that grow later in the roots from which halo-hairs have been shed. This is to be done by way of showing the practical bearing of details which do not lend themselves to observation in the sheep-yards.

This account, like the earlier articles in this series, has reference, save where otherwise stated, to the middle of the back at the level of the last rib.

In the preceding article it was explained that the several fibre type arrays are distinguished by lesser or greater effects of the pre-natal check acting upon the fibres beginning to grow at a certain early stage before birth. It is a general rule in the development of the coats of mammals that the earlier a fibre begins to grow the bigger it is. This principle of initial advantage is of course of wide application. The fibres starting earlier are coarser and grow faster. Those that start to grow progressively later tend to be finer and grow more slowly. On the back of most lambs this rule does not hold completely. As one proceeds from the early to the late end of the fibre type array—that is, from the halo-hairs, to sickle-fibres, to curly-tip fibres, and to fibres without definite curls in the tip—it is true that the fibres do on the whole become finer. At the same time, it frequently happens that some of the sickle-fibres

* *Journal*, January, March, and May, 1933.

(fine sickle-fibres) and often, too, some curly-tip fibres (checked curly-tip fibres) are finer than the fibres standing next to them, both earlier and later, in the fibre type array. By its effect upon these sickle-fibres and curly-tip fibres, less pronounced or more pronounced, is the pre-natal check judged, and it is in this way, as explained before, that the fibre type arrays are classified. It would appear that the follicles that have reached a certain stage of development, at the time when this checking force is powerful, suffer more severely not only than those roots which are better established, but than those roots which are then at an earlier stage. If this be so, there is a critical stage of development at which a follicle is especially susceptible to the restricting influence of the pre-natal check. Studies of the development of the coat before birth are being made in my laboratory in the hope that something may be learnt about this checking force which must be postulated in order to explain so many features in the fibre types, and in the different collections of fibre types called arrays.

The Fibre Type Arrays.

The several fibre type arrays are now to be described somewhat more fully than in the last article. More will be said than previously about variations within the same kind of array, and about collections of fibres standing on the border-line between two arrays. Thus it happens sometimes that the fibres important in classifying the array are only slightly fine. At other times it happens that the fine fibres in question are very few compared with the coarser fibres with similar tips. Most of the names adopted for the arrays were suggested by Mr. Rudall. With one exception, they are taken from topographical features, and give some impression of the effect attributed to the pre-natal check that is observable when representative fibres are arranged in the order of starting to grow.

The Plateau Array.—In this array (Fig. 1) there are no sickle-fibres. When the fibres are arranged in logical order there is a transition from halo-hairs to curly-tip fibres without any sickle-fibres standing between. Generally, there are fibres classed as super-sickles, with a large sickle-shaped end and coarse medulla in the neck region that is grown before birth, but there are no fibres with such apical ends with the neck which follows fine and not chalky throughout. Sometimes it is stretching a point to recognize even super-sickles, the transition being rather from halo-hairs to curly-tip fibres with hairy tips. In this array hairiness is usually much in evidence in the tips of big curly-tip fibres.

The pre-natal check is clearly unable to cause the neck of any fibre with a sickle-shaped end to be fine enough for that fibre to be classed as a sickle instead of a super-sickle. One explanation is that the check is feeble, another that the follicles of big fibres besides the halo-hairs have it in them to produce such coarsely hairy fibres that even a powerful or fairly powerful check is not able to make thoroughly fine the neck region of any fibre approaching a sickle-fibre in form. All my lambs with this array on the back have had grossly hairy curly-tip fibres.

All these lambs, it also happens, have had many halo-hairs on the back, but they have all been produced in breeding experiments in which they had an excellent chance to be born with many halo-hairs. The Plateau array is more common on the britch, where the coat is so

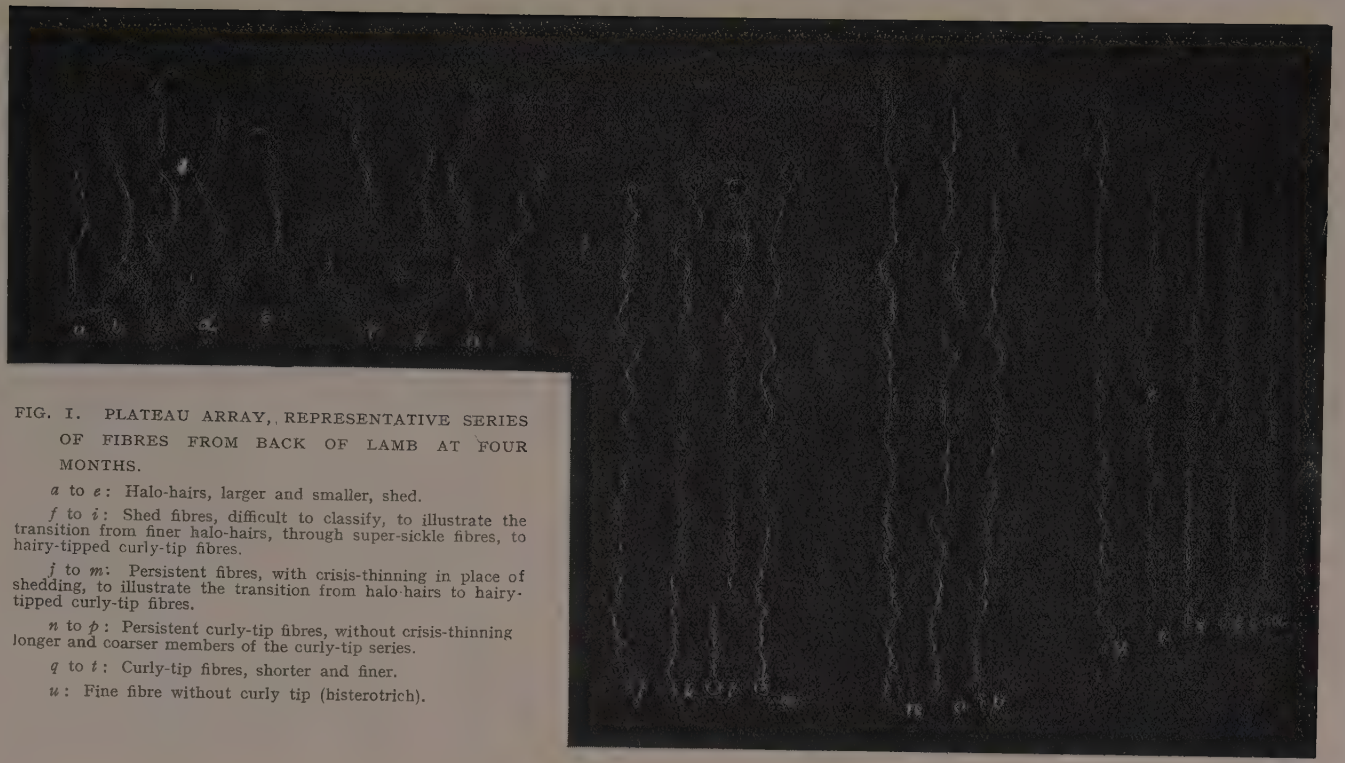

FIG. I. PLATEAU ARRAY, REPRESENTATIVE SERIES OF FIBRES FROM BACK OF LAMB AT FOUR MONTHS.

a to *e*: Halo-hairs, larger and smaller, shed.

f to *i*: Shed fibres, difficult to classify, to illustrate the transition from finer halo-hairs, through super-sickle fibres, to hairy-tipped curly-tip fibres.

j to *m*: Persistent fibres, with crisis-thinning in place of shedding, to illustrate the transition from halo-hairs to hairy-tipped curly-tip fibres.

n to *p*: Persistent curly-tip fibres, without crisis-thinning longer and coarser members of the curly-tip series.

q to *t*: Curly-tip fibres, shorter and finer.

u: Fine fibre without curly tip (histerotrich).

often very coarse and hairy, and while halo-hairs are often plentiful there, Miss Galpin has found arrays on the britch best regarded as Plateau in which the fibres at the beginning of the array are only big enough to be considered super-sickle-fibres instead of halo-hairs.

It is a noticeable feature in this array that, as we proceed along the series of curly-tip fibres, from those with longer tips and more curls, to those with shorter tips and fewer curls, we may encounter a sudden drop in hairiness. It then comes about that with tips above a certain size almost all the fibres are very coarsely hairy, while with tips below a certain size almost all are much finer and less hairy. Accompanying differences in coarseness are corresponding differences in rate of growth in length, and these differences may be very marked. The staple then has a long-drawn-out or very wasty tip.

Sometimes in very coarsely hairy specimens that do contain sickle-fibres there will be a smaller number of fibres that fall into a Plateau series. These fewer fibres constituting a Plateau series are said to be "in parallel" with a Saddle array, or even with a Ravine array.

The specimens showing the Plateau array have always had the biggest persistent birthcoat fibres, from persistent super-sickles—even a few persistent halo-hairs may be present—to fibres some way along the curly-tip series, very hairy indeed. When in the same specimen halo-hairs are very abundant we have lambs conspicuously objectionable for hairiness on both counts.

The Saddle Array.—In this array (Fig. 2) chalky sickle-fibres are present, but not fine sickle-fibres. There is a direct transition from chalky sickle-fibres to chalky curly-tip fibres. This is another comparatively simple array. The pre-natal check is regarded as able to bring about the marked thinning in the necks of sickle-fibres, but as not powerful enough, in a typical Saddle array, to cause any of these fibres to remain fine after birth.

In some arrays classed as Saddle just a few fine sickle-fibres, or fine sickle-fibres and checked curly-tip fibres, are to be found, and are called in parallel with the Saddle series. In specimens from the back of a small number of lambs in which the great majority of the sickle-fibres—whether with large ends or with small ends—and of the curly-tip fibres with the longest tips, become chalky after birth, and in which the majority of the sickle-fibres of both sorts, together with some few chalky curly-tip fibres, are shed, there are present also appreciable numbers of fine sickle-fibres, some with larger sickle-ends, some with smaller, and checked curly-tip fibres. It thus comes about that there is present every known sort of fibre belonging to the region of the array upon which the classification of the array hinges. This array is called All-in. Amongst all these types chalky fibres are in the majority, so that the array is akin to Saddle. There is also much shedding, and shedding, as will be more apparent later in this account, tends to accompany a weak pre-natal check.

Occasional arrays are found, not very easy to place, in that while there are present relatively fine fibres on account of which one is inclined to call the array Ravine or Valley, as the case may be, yet these finer fibres are coarser than those of a typical array of the kinds just named.

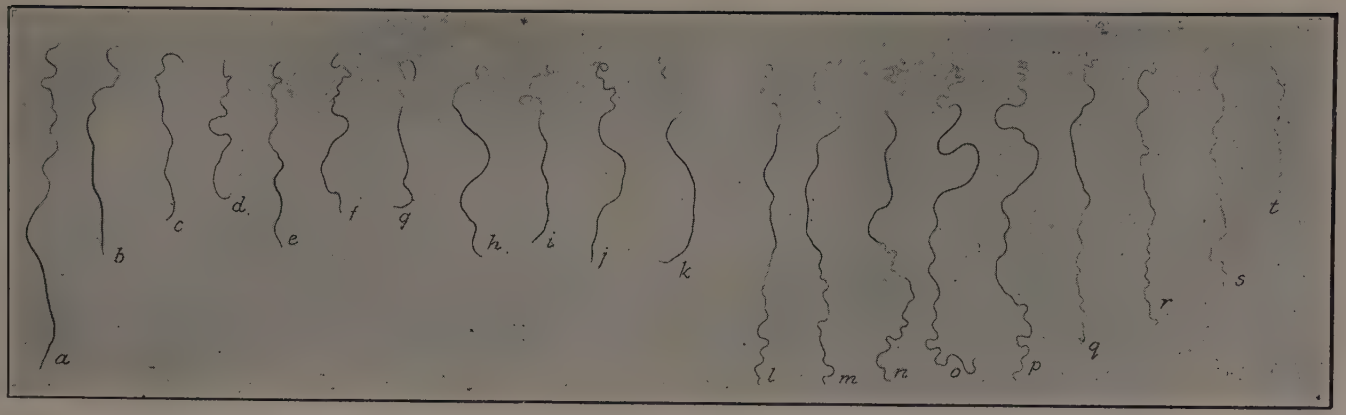

FIG. 2. SADDLE ARRAY, DIAGRAMS OF REPRESENTATIVE FIBRES, FROM BACK OF LAMB AT FOUR MONTHS. AS IN SIMILAR FIGURES, THE FIBRES ARE DRAWN AT NATURAL LENGTH, BUT DIFFERENCES IN DIAMETER ARE EXAGGERATED.

Shed :—
- *a*: Halo-hair, large.
- *b*: Small halo-hair or large super-sickle-fibre.
- *c* to *f*: Super-sickle-fibres.
- *g* to *i*: Sickle-fibres, with sickle-ends large to small.
- *j*: Hairy-tipped curly-tip fibre.
- *k*: Curly-tip fibre, not hairy-tipped.

Persistent :—
- *l*: Sickle-fibre with crisis-thinning.
- *m*: Hairy-tipped curly-tip fibre with crisis-thinning.
- *n*: Curly-tip fibre, not hairy-tipped, with crisis-thinning; tip with very many curls.
- *o* to *r*: Curly-tip fibres, none with crisis-thinning, showing progressive reduction along the series in number of curls in the tip, in coarseness, and in length.
- *s*, *t*: Fine fibres without curly tips (histerotrichs).

The Saddle array has not been very common on the back in my material. Generally, the non-kemp portion of the Saddle array has been very hairy, or decidedly so. Sometimes hairiness extends well along the array—that is to say, to curly-tip fibres with tips by no means long, but sometimes the only curly-tip fibres that are hairy are those with the longest tips.

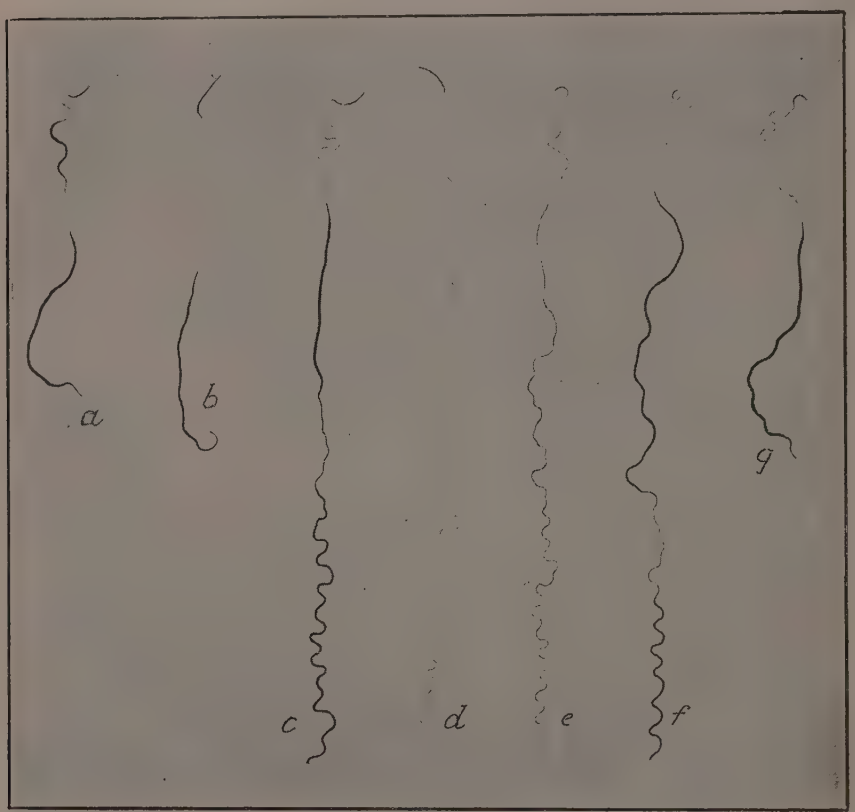

FIG. 3. ,RAVINE ARRAY, DIAGRAMS OF FIBRES SELECTED TO SHOW THE ESSENTIAL FEATURES OF THIS ARRAY.

a: Super-sickle-fibre, shed.
b: Sickle-fibre with large sickle-end, shed.
c: Hairy sickle-fibre with large sickle-end, persistent, with crisis-thinning.
d: Fine sickle-fibre with large sickle-end.
e: Fine sickle-fibre with small sickle-end.
f: Hairy sickle-fibre with small sickle-end, persistent, with crisis-thinning.
g: Sickle-fibre with small sickle-end, shed. From the last fibre there is a direct transition to curly tip fibres hairy in the post-natal region.

It is to be noted, though this feature is not a universal rule in similar series, that the post-natal hairy region grown before shedding or crisis-thinning is longer in the hairy sickle-fibres with small sickle-ends, placed late in the series, than in hairy sickle-fibres with large ends and in the super-sickle-fibre figured, placed early in the series.

The Ravine Array.—In this array (Fig. 3), as in Saddle, there is a transition from chalky sickle-fibres with small ends to chalky curly-tip fibres, but within the series of sickle-fibres, with sickle-fibres on the whole of medium size, are considerable numbers of fine sickle-fibres. The failure of these fibres to become coarse after birth is regarded, as intimated already, as an effect of the pre-natal check.

On these fine sickle-fibres, therefore, the pre-natal check has produced a marked effect. In wool specimens not unduly coarse that show this array, the check is to be looked upon as becoming powerful, but remaining so for only a short time in pre-natal development. In coarser-woolled specimens with this array we may suppose that the checking-force is really more powerful, but that, owing to the inherent coarseness of the fibres beginning to grow about the critical time, not many of them are kept down to a fine diameter.

More is to be said about the shedding of chalky sickle-fibres later in this article; a pre-natal check acting powerfully, there is reason to believe, tends to prevent shedding. In the Ravine array it sometimes happens that there are two well-defined groups of shed sickle-fibres, one with larger ends, the other with smaller ends. The follicles of the sickle-fibres of the first group may be regarded as having become well established before the check becomes intense, those of the second group as not having developed far enough to be exposed to the full force of the check. Accompanying both these groups of shed sickle-fibres, or associated only with the first group, are frequently fibres with a short thin region in place of shedding. In consequence, as will readily be appreciated from what was said in this connection in the article on sickle-fibres, there are multitudinous differences in detail between Ravine arrays which it will be permissible to refrain from describing.

The Ravine array, while occurring in some very hairy specimens, is more common amongst those with the persistent birthcoat fibres not coarsely hairy.

The Valley Array.—In this array (Fig. 4) checked curly-tip fibres, followed along the array by coarser curly-tip fibres, are the key type. Many sickle-fibres, especially those standing later in the array, the ones with smaller ends, linked by transitional fibres with a mere suggestion of a sickle-end with the checked curly-tip fibres, are also fine, so that the total suppressing effects of the check on fibre diameter are pronounced.

Amongst variations in Valley arrays we may note—

(*a*) Differences at the beginning of the array.

Super-sickles remaining fine after birth are sometimes common in this array, being known also in some Ravine arrays. Here it would seem that the check has become intense especially early.

(*b*) Differences in the fineness of the part of the array most affected by the pre-natal check.

In some arrays the sickle-fibres, and, it may be, the checked curly-tip fibres also, are conspicuously fine, and this when big curly-tip fibres are present as coarse as any in some Ravine and even Saddle arrays. The differences now under consideration are to be put down to differences in the intensity attained by the pre-natal check.

(*c*) Differences at the late end of that section of the array markedly affected by the pre-natal check.

Sometimes only curly-tip fibres with very many curls in the tip belong to the checked group. On the other hand, this group may also contain quite a number of fibres with appreciably fewer curls in the tip.

Clearly, therefore, there are differences in the stage of pre-natal development at which the powerful influence of the check subsides.

It has already been stated that this array is known in lambs with the coarsest curly-tip fibres quite hairy, but very many of the animals with this array on the back are fine-woolled and only slightly hairy in the fibres that escape the full force of the check by starting to grow relatively late.

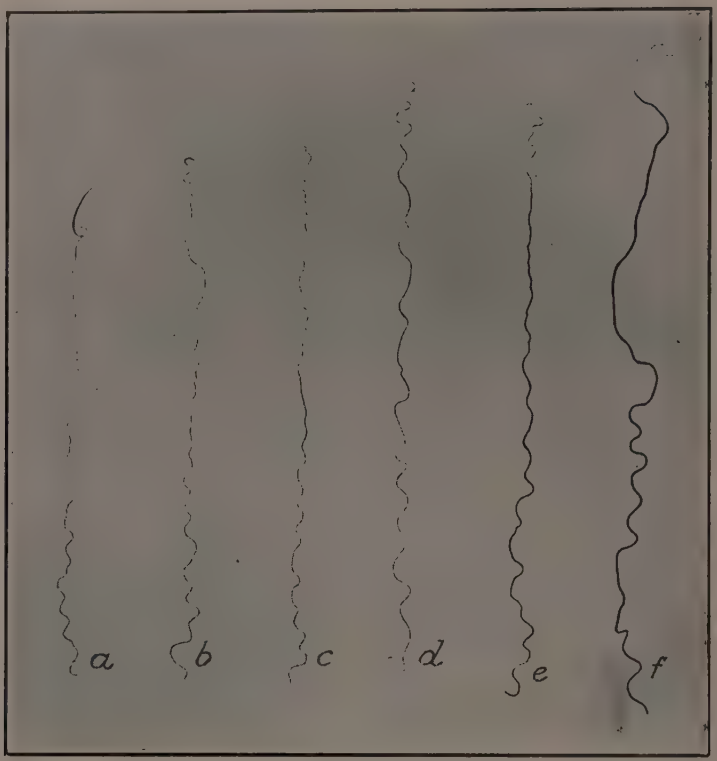

FIG. 4. VALLEY ARRAY, DIAGRAMS OF FIBRES TO SHOW THE ESSENTIAL FEATURES OF THIS ARRAY.

a: Fine sickle-fibre with large sickle-end.
b: Fine sickle-fibre with small sickle-end.
c: Fibre transitional between fine sickle-fibre and checked curly-tip fibre.
d, *e*: Checked curly-tip fibres.
f: Peak curly-tip fibre, with relatively few curls in the tip, hairy after birth, as coarse as any persistent fibre in the array.
Fibres placed earlier and later in the array are not shown.

When fine sickle-fibres are present, and all the curly-tip fibres are quite fine, the array is called Plain. Such specimens show no more than negligible hairiness in the curly-tip fibres.

Variations in Hairiness in Terms of the Fibre Type Array.

To variations in detail in the characterization of the hairiness of the coat of the lamb there is no end. Of most of the features that vary and that are now to be considered some mention has already been made.

1. *Variations in the Type with which the Array begins.*—In accounts of this research it has been necessary to say so much about halo-hairs that rather little prominence has perhaps been given to the fact that many lambs are entirely free from halo-hairs on the back. In such specimens, too, there are often no super-sickle-fibres. When the array begins with sickle-fibres, chalky sickle-fibres may or may not be present. Not infrequently all the sickle-fibres are fine. Occasionally, though very rarely, it is stretching a point to call any fibres sickles. When anything approaching a sickle-end is barely existent we may consider the array to begin with curly-tip fibres.

There are two ways of regarding an array which lacks one or more major types at the early end. It may be that corresponding roots will grow one type of fibre in one animal, another in another, so that, as determined by certain undefined conditions, a given follicle may in one lamb give rise to a halo-hair, in another to a sickle-fibre. On the other hand, it is possible that in some lambs the coat is later than in others in beginning its development, in the sense that follicles capable of producing fibres standing at the beginning of the array are not founded at all. This question has received some attention from Miss Galpin and myself. It seems likely that both interpretations will have their use. It may be added, without discussing the matter further now, that for really fastidious breeding there will be a lot of things worth knowing about the beginning of the fibre-type array of a wool specimen free from halo-hairs.

2. *Variations in Hairiness irrespective of the Pre-natal Check.*—When a particular result is brought about by two different kinds of interacting factors it is a difficult matter to disentangle their effects. It is clear, however, that in different wool specimens there must be great differences, not only in the restricting effect of the pre-natal check, but in what may be termed the intrinsic or inherent coarseness and hairiness. A grossly hairy lamb, like those with the array Plateau, must be regarded as so coarsely hairy not because, or only because, the pre-natal check may be feeble, but for the reason that, apart from this, the lamb has it in it to grow excessively hairy wool.

Of this inherent hairiness we may distinguish the following aspects :—

(*a*) Variations in the maximum coarseness of hairiness of big fibres occupying a corresponding position in the array. This character may be judged more especially by the hairiness of the stoutest curly-tip fibres.

(*b*) Variations in the distance along the array to which hairiness extends, the fibres being judged by the region grown in the first two months or so after birth.

Sometimes all the curly-tip fibres are hairy, and, now and again, even some of the non-curly-tip fibres which evidently begin to grow later than the curly-tip fibres, the tips of the non-curly-tip fibres first passing through the skin around the time of birth. Generally, as we proceed along the curly-tip series, from the coarsest fibres with more curls in the tip to fibres with fewer curls in the tip, there is a marked reduction in hairiness. Sometimes, as mentioned in discussing the Plateau array, this drop in hairiness along the array is a sudden one. In the extreme condition, short of complete freedom from hairiness in curly-tip fibres, only a very few such fibres, with long tips, are hairy.

In fine-woolled specimens with none of the curly-tip fibres medullated, we are not in a position to say to what extent the fineness of the curly-tip fibres early in the series is due to the intrinsic fineness of the specimen, to what extent to the pre-natal check. Repeatedly in the study of mammalian hair it proves necessary to attribute the same effect to different causes, and in this instance there is probably truth in both these explanations.

The statement just made has reference to the Plain array. We must indeed be prepared for the existence of some Plain arrays which are not hairy, for the reason that they are intrinsically not hairy, because they have not got it in them to be hairy, whatever the pre-natal check. On the other hand, it is very likely that in other Plain arrays long-tipped curly-tip fibres would be somewhat hairy were they not prevented from being so by the pre-natal check. If animals with two Plain arrays differing in the way suggested were mated together, there is one obvious interpretation if their offspring should prove to have somewhat hairy long-tipped curly-tip fibres.

(*c*) Variations in hairiness along the length of the fibre.

Something has been said in earlier articles about differences in hairiness in corresponding fibres in passing from the tip to the butt of the staple. As pertinent to the shedding of chalky sickle-fibres, which is to be discussed later in this article, it may here be mentioned that if in the curly-tip fibres coarse hairiness is sustained clearly beyond the crisis level—that is, further towards the butt than the length of a shed chalky sickle-fibre—then these sickle-fibres tend to shed less readily than otherwise. It would seem that the inherent tendency to sustained hairiness shared by the follicles of the chalky sickle-fibres and curly-tip fibres enables many follicles to continue active when, otherwise, they would enter upon a dormant phase.

3. *Variations in the Kind of Pre-natal Check.*—The existence of these variations is evident enough from the description of the several fibre-type arrays, and especially from what has been said about the Valley array. When the comparison is between different arrays the contrast is greater. In animals in which the coarseness of the inherent hairiness, as judged both by fibres very early in the array and by coarse curly-tip fibres, appears to be much the same, we may detect differences attributed to variations in—

(*a*) *The onset of the check.*—To take an extreme condition, cited already, super-sickle-fibres remaining fine after birth may be very plentiful, or, on the other hand, all these fibres may become hairy after birth.

(*b*) *The intensity of the check.*—Fine sickle-fibres alone, or in company with checked curly-tip fibres, may or may not be found. When present they vary from slightly fine to especially fine.

(*c*) *The decline of the check.*—Even after the check has been intense, as testified by fine sickle-fibres, we may suppose it in a Ravine array rapidly to subside, or, at the other extreme, in some Valley arrays to cause quite a section of the series of curly-tip fibres, including those with the most curls in the tip together with others having appreciably fewer curls, to be finer than the stoutest curly-tip fibres which then occupy a position relatively late in the array.

The situation thus revealed is a complicated one, and it is not inappropriate that it should be so in the covering of that animal which produces the most valuable of mammalian coats. No little exercise is provided for our wits in winning the accurate knowledge needed for the exploitation of the fleece of the sheep. The details that have been accumulated, which are now linked together in one coherent story, supply an essential basis for future research, and especially for experimental work not only on hairiness, but upon the factors determining fleece-weight, or the effects of nutrition on the fleece. These somewhat elaborate details have besides direct bearing upon selection against hairiness, as will be made clear by the short account which follows of the main facts about the continued growth of kemp after the shedding of the halo-hairs.

The Fibre Type Array and Kemp in the Hogget Fleece.

This concluding section is a preliminary report upon one aspect of the present research that is put forward now in order to show the practical significance of the story of the fibre type arrays that has been related. The statement now made has reference to specimens from the back in which coarse hairiness in persistent birthcoat fibres is not sustained below the crisis level, there being evidence that such shedding interferes with the shedding of sickle-fibres. When such lambs with little shedding of sickle-fibres are taken into account the generalization now made is not contradicted, in that few of the halo-hairs are succeeded by kemps, but the fibres that follow them in the same roots tend to be distinctly hairy, reflecting the hairiness of the persistent birthcoat fibres.

When halo-hairs fall out they are succeeded by other fibres which may be kemps, that is, rather short, very hairy fibres themselves shed in their turn; or they may be hairy, more so or less, of persistent growth; or they may be unobjectionable. The shed successors of halo-hairs are called secondary kemps to distinguish them from birthcoat kemps. In this matter of succession there are great differences between individual lambs.

A relation exists between the degree of hairiness and the shedding of the successors of halo-hairs and the extent to which the sickle-fibres with large ends have shed. The shed sickle-fibres also are followed in the same roots by other fibres, which are scarcely ever shed, that are sometimes hairy, and in general run parallel, at a lower level, with the hairiness of the successors of the halo-hairs in the same specimen. With these fibres that succeed sickle-fibres we are not, however, now concerned.

The presence of a big proportion of secondary kemps amongst the immediate successors of halo-hairs is correlated with the shedding of a substantial majority, usually three-quarters or more, of the big-ended sickle-fibres. This free shedding of the big-ended sickle-fibres has been found in Saddle, Ravine, and Valley arrays, but in my material it has occurred more consistently in the Saddle arrays.

When the immediate successors of halo-hairs are shed, they again are followed by other fibres in the same roots, which may or may not be shed kemp, and to these again the same applies. If the

halo-hair follicle continues to grow kemps up to the time of the shearing of the hogget at about fourteen months, three such secondary kemps are sometimes grown, one after the other, in the same follicle. The usual number is probably two, when a third kemp-like fibre is often growing at the time of shearing. The extent to which the growth of kemp is continued throughout the growth of the first fleece can thus best be judged from the second "generation" of secondary kemp, the fibres which, counting the original halo-hairs, are the third occupants of their follicles. For studying succession, examination in benzol has been an extremely useful method.

In those lambs in which, on the standard back position, the growth of kemp is continued late in the first year in a fair proportion of the halo-hair follicles, not only have a big majority of the sickle-fibres with large ends been shed, but the fibre-type array has been Saddle, or the allied All-in array. In those specimens where much secondary kemp succeeds the halo-hairs, but in which the growth of secondary kemp is not continued in any abundance later in the year, the array has been Ravine or Valley.

There are reasons for believing that to produce a hairy fibre which is shed in a normal manner, after a certain growth period—that is to say, to grow a kemp—is a very vigorous thing for a follicle to do. Amongst other evidence it may be noted that the stoutest of birthcoat fibres, halo-hairs, are almost all shed, and that the super-sickle-fibres, with necks coarser than those of sickle-fibres, shed the more readily. There is evidence also that poor growth of the lamb in the first two months, accompanied by recognizable abnormality in the growth of the fleece, hinders the shedding of chalky sickle-fibres.

It may appear paradoxical that vigorous activity on the part of the follicle should lead to shedding. My interpretation is that if a follicle works extremely hard it is compelled to take a rest. On this view a series of very vigorous periods of fatiguing activity, separated by recuperating quiescent intervals, gives a succession of secondary kemps. After the first two or three months there is usually some reduction in the general vigour of the growth of the fleece, as evidenced by the usual reduction in the coarseness of hairy fibres, for hairiness, as explained in an earlier article, is also looked upon as the expression of vigour on the part of the follicle. With this reduction in vigour may be correlated the almost invariable failure of a sickle-fibre follicle to grow a secondary kemp. With hairy sickle-fibres it is clearly much more touch-and-go than with halo-hairs, whether they cease growth and fall out, or remain in the skin as fibres of persistent growth. The continued growth of a series of secondary kemps in a halo-hair follicle we are to regard as achieved in spite of the reduction in the general vigour of the growth of the fleece.

On the view put forward it is thus a vigorous thing for many big-ended sickle-fibres to be shed, and so it is for the growth of a series of secondary kemps to be kept up, one after the other in the same follicle, throughout the first year. These two performances run parallel. Now when the immediate successors of many halo-hairs are secondary kemps, then, if the array is Saddle (or All-in), a good deal of kemp continues to be grown later in the year. If, on the other hand, the array is Ravine or Valley, the growth of secondary kemp is

not kept up well later in the year. When the array is Saddle a weak pre-natal check is indicated, when Ravine or Valley a more powerful one. The more intense pre-natal check, it is concluded, has impaired the vigour of the halo-hair follicles sufficiently to prevent more than a few of them from growing secondary kemp late in the first year.

For this repeated production of secondary kemps, therefore, the essential condition is that the pre-natal check should not be powerful. Whether halo-hairs be abundant, scarce, or absent, the check may be weak or intense. In some specimens with few or no halo-hairs the fibre-type array, and the shedding of sickle-fibres, reveal just those conditions which, were halo-hairs present, would permit the growth of a series of secondary kemps. The significance of this from the point of view of breeding is obvious. Thus is demonstrated the practical consequence of the kind of fibre type array.

ACKNOWLEDGMENTS.

While this research has been in progress there has been co-operation between the College and the Department of Scientific and Industrial Research. The figures illustrating this article have been prepared by Mr. M. T. Gabriel.

THE CONTROL OF FLEAS.

THE following information is extracted from a statement which has been kindly supplied by Miss E. A. Plank, Entomologist, Dominion Museum :—

At the present time throughout New Zealand there appears to be what may be termed an epidemic of fleas which, although not likely to cause any outbreak of disease, occasion much discomfort and annoyance.

The following control measures against an epidemic of fleas are suggested in a British Museum pamphlet by James Waterson :—

(1) Moth-balls kept in one's clothes help to repel the insects from wearing-apparel.

(2) Oil of eucalyptus in sheets repels insects.

(3) Wash infected dogs and cats with good carbolic soap, rinsing well afterwards. A 3-per-cent. solution of creolin (warm) has been used with excellent results. Leave animal in for five to ten minutes, then wash in warm water and soap. Care must be taken to clean the head.

(4) All cracks in floors and walls should be filled up or a solution of naphthalene (crushed moth-balls) in benzene poured down. (Care must be taken to avoid fires till benzene has evaporated.)

(5) In outbuildings rubbish should be burned and walls and floors should be washed down with some creosote preparation or a petroleum or paraffin emulsion. Such an emulsion when diluted with water (1 in 20 or even more) will kill all fleas that it touches on floors.

Emulsion.—Three parts of soft soap are thoroughly melted by heat in 15 parts of water and whilst still hot 70–100 parts of the oil (petroleum, kerosene, or paraffin) are added gradually with much shaking or stirring. Note: The proper emulsification depends on the *gradual* addition of the oil and thorough agitation. The final mixture should be white and creamy with no free oil. Oil emulsions made with the light or more volatile oils are quicker in action and more penetrating than those made with heavy oils. They are, however, more rapidly dispersed by drying off and evaporation.

TOMATO-MOSAIC.

ITS APPEARANCE, CAUSE, AND PREVENTIVE TREATMENT.

E. E. CHAMBERLAIN, Mycological Laboratory, Plant Research Station, Palmerston North.

TOMATO-MOSAIC is a very troublesome disease in certain of the tomato-growing districts of New Zealand. Although it has probably been present in this country for many years it was not recognized as mosaic until 1924, when it was observed on glasshouse tomatoes in Nelson. It has since been noted in the Auckland, Poverty Bay, Hawke's Bay, Wellington, Canterbury, and Otago districts. Tomato-mosaic is of world-wide distribution, and has been recorded from Europe, North and South America, South Africa, and Australia. The disease occurs in this country on both glasshouse and field crops, but is more common on the former.

SYMPTOMS.

Two types of mosaic occur on tomatoes in this country. Mild mosaic is characterized by a dark- and light-green mottling of the leaves (Fig. 1), this mottling being most readily seen when the leaves are shaded or held up to the light. The leaves are usually smaller than the normal and sometimes show a puckered or uneven surface owing to the unequal rates of growth of the dark- and light-green areas. The plants themselves are slightly stunted (Fig. 2), the amount of foliage reduced, and the yield of fruit lessened. Leaf symptoms appear only on those leaves which develop after infection has taken place, so that plants which become infected late in the season show mosaic symptoms only on the new growth. The stems of infected plants may be less sturdy than those of healthy plants, but they retain their normal green colour. The fruit is not mottled or marked in any way.

Severe mosaic has much more pronounced symptoms. The leaves are small, mottled, and curled, and show small dark areas of dead tissue (Fig. 1). Dark streaks also appear on the stem. Plants infected in the seedling stage remain much stunted (Fig. 3), while those infected later in the season fail to set fruit on the upper trusses and many of the leaves die and fall (Fig. 4). Ripe fruit from infected plants often shows a pronounced yellow and red mottling (Fig. 5).

ECONOMIC IMPORTANCE.

Although mosaic has been observed in both glasshouse and field in most districts, it is only in the former that serious losses have been experienced. Mild mosaic, which is much the more common of the two diseases, has been observed to the extent of 100 per cent. in some glasshouses in Nelson, while 10 per cent. infection has been reported from Auckland.

Field trials to determine the effects of mild and severe mosaic on crop yield have been carried out at the Plant Research Station, Palmerston North. Sixty-five plants infected with mosaic at the seedling stage were compared with sixty healthy plants. The mild mosaic produced a distinct mottling of the leaves, and, although it did not

have much effect on the size or appearance of the plants, it reduced the average yield from 6·7 lb. in the healthy plants to 4·1 lb. in the infected. This represents a reduction in yield of 39 per cent.

The plants infected with severe mosaic were very much stunted and the fruit was small and mottled, none being marketable. The average yield per plant was reduced from 5·78 lb. in the healthy plants to 0·51 lb. in the infected plants, this representing a yield-reduction of 91·2 per cent.

Cause.

Tomato-mosaic belongs to a well-defined group of plant diseases known as plant viruses. These viruses are infective principles which are difficult to define, since they cannot be demonstrated by any of

FIG. 1. MILD AND SEVERE MOSAIC OF TOMATOES.

(*a*) Leaf from healthy plant.
(*b*) Leaf from plant infected with severe mosaic.
(*c*) Leaf from plant infected with mild mosaic.

the known mycological or bacteriological methods. Thus they cannot be isolated and grown on artificial media, and they cannot be seen under the microscope. The proof of the virus nature of any disease consists of being able to reproduce the symptoms on a healthy plant either by transferring to it insects which have fed on the diseased plant or by artificially inoculating it with juice extracted from the diseased plant.

In other countries it has been shown that mild mosaic of tomatoes is brought about by the same virus as causes mosaic of tobacco (Walker, 1926; Schaffnit and Mueller, 1931; Ainsworth, 1933). Inoculation experiments and a study of the symptoms of tomato-mosaic on several hosts has shown that this is also true for the disease as it occurs in New Zealand.

Host Range.

Experiments carried out in the other countries show that the mild mosaic of tomatoes has a wide host range, most of the wild and cultivated Solanaceous plants being susceptible (Gardner and Kendrick, 1922 (*a*); Bewley, 1923; Schaffnit and Mueller, 1931). In experiments carried out at this Station both mild and severe mosaic were transmitted from tomato to tobacco, Cape gooseberry (*Physalis peruviana*), and black night-shade (*Solanum nigrum*). Of these hosts only tobacco shows

FIG. 2. MILD MOSAIC OF TOMATO.

Glasshouse-grown tomato-plants. Healthy plant on left and mild mosaic-infected plant on right.

a high percentage of infection in the field. The mild mosaic form is prevalent throughout the tobacco crops in the Nelson District, and in individual fields over 90 per cent. of infected plants have been observed. This disease also occurs on tobacco in the Auckland District. Specimens of Cape gooseberries infected with mosaic have also been forwarded to this Laboratory. In this country severe mosaic is not known to occur naturally on any host other than tomato, while mild mosaic has not been observed on black night-shade.

Factors affecting Control.

Spread of the Disease on the Hands and Pruning-knives.—The tomato-mosaic virus is very infectious, and it has been shown (Walker, 1926) that the juice extract from an infected plant may be diluted to 1 in 10,000 and still bring about infection. Although the virus can gain entrance to the plant only through wounds, the mere touching of a leaf with the fingers causes sufficient injury, by breaking the leaf hairs, to allow infection to take place. Infection is readily carried from diseased

FIG. 3. SEVERE MOSAIC OF TOMATO.

Glasshouse-grown tomato-plants. Severe mosaic-infected plant on left, healthy plant on right.

to healthy plants on the fingers or pruning-knives (Bewley, 1923). Experience at this Station has shown that the virus may be removed from the hands by thorough washing with soap and running water.

Transmission on the hands and pruning-knives appears to be the main method of dissemination in New Zealand, and field experiments have been carried out to determine the extent to which mosaic may be carried on the fingers. Eighteen healthy plants were pruned immediately after mosaic plants had been handled, and then after thoroughly washing

the hands, the laterals were removed from a further twenty-four plants. Of the former, seven of the eighteen plants developed mosaic, while of the latter all twenty-four plants remained healthy.

Dissemination by Insects.—The natural method of spread of most virus diseases is by means of insects. Overseas work has shown that several species of insects are capable of transmitting tomato-mosaic, and among these are the two aphides, *Macrosiphum gei* and *Myzus pseudosolani* (Hoggan, 1930). Both these aphides are plentiful in New Zealand, and the former is commonly found on tomatoes.

FIG. 4. SEVERE MOSAIC OF TOMATO.

Plant on left infected with severe mosaic comparatively late in the season. Plant on right healthy.

From observations made at this Station it would appear that the spread of tomato-mosaic in the field by means of aphides is not extensive. Of a plot of forty-eight healthy plants grown alongside plants infected with mild mosaic and others infected with severe mosaic not one developed mosaic. The aphides *M. gei* and *Myzus persicae* were plentiful on both the diseased and healthy plants during the early part of the season.

Transmission through the Seed.—Seed transmission of tomato-mosaic was recorded by Westerdijk (1910). Although later workers (Allard, 1916; Gardner and Kendrick, 1922 (*a*)) were unable to confirm this, her conclusions have been supported by the more recent work of Bewley

and Corbett (1930), who record seed transmission to the extent of 6 per cent. Berkeley and Madden (1932, 1933) have also recorded seed transmission of tomato-mosaic.

Glasshouse experiments carried out at this Station have shown that of eighty-four plants grown from seed collected from plants infected with mild mosaic five developed mosaic. From evidence obtained from observations in commercial glasshouses in the Nelson District it would appear that the use of seed from infected plants plays an important part in the carrying-over of infection from one season to the next.

Spread from other Hosts.—The only other host on which the disease occurs extensively is tobacco, and where both tomatoes and tobacco are being grown by the same grower every precaution should be taken not to transfer the disease from the one crop to the other.

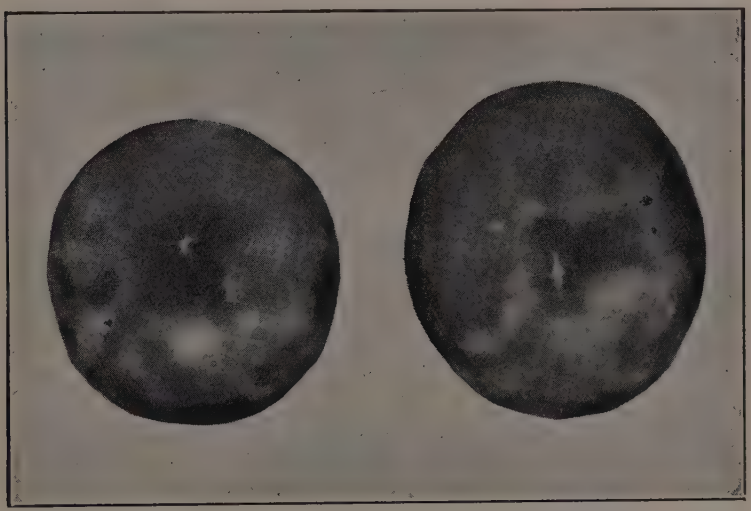

FIG. 5. MOTTLED FRUIT FROM PLANTS INFECTED WITH SEVERE MOSAIC.

Cape gooseberries occasionally show mosaic, and with these plants there is an added danger for, being perennials, they are capable of carrying the disease over from the one season to the next, so that all infected plants should be removed. For this reason also they should not be allowed to grow as a garden escape in or about tomato crops.

Although mosaic has not been found to occur naturally on black night-shade, it is capable of infection, and since it sometimes lives through the winter in sheltered spots it may carry the disease over to the next season. Growers should therefore, during the winter, remove all black night-shade plants growing in sheltered places about the tomato-garden.

Transmission through the Soil.—Tomato-mosaic is systemic—that is, it is present in all parts of the plant, including the roots. The virus can withstand drying and remains viable in the juice extract from infected plants for at least 138 days (Walker, 1926). It would be expected from this that where the remains of infected plants are not

removed the virus might remain in a viable condition in the soil for some time. It has been shown by Doolittle (1928) that tomato-mosaic is capable of living in glasshouse soils for at least seventy days, and in field soils for from four to six weeks. Experiments carried out at this Station have demonstrated that the virus of the mild mosaic form from tobacco is capable of remaining viable for eighty days in soil contained in boxes and allowed to remain exposed to the weather.

It has been shown that the virus of tomato-mosaic is killed by exposure to a temperature of between 176° F. and 185° F. for ten minutes (Walker, 1926). Steam sterilization of the soil would therefore destroy the disease. That soil transmission is not necessarily the important factor in the overwintering of mosaic is shown by the fact that this disease is severe in Nelson glasshouses where steam sterilization is carried out every year.

Incubation Period of Tomato-mosaic.—There is an interval between the time a tomato plant becomes infected with mosaic and the time the first symptoms appear. This interval is known as the incubation period, and varies from six days in the summer when the plants are growing vigorously to three weeks in the winter when the plants are making little growth. During the latter portion of the incubation period the juice of the plant is infective and the plant is a potential source of infection. For this reason, when once mosaic has appeared in the crop, an interval of about fourteen days should be left between prunings. This gives an opportunity for all plants infected at the previous pruning to show the symptoms and to be removed before any of the plants are again pruned.

Masking of Symptoms.—Under shady conditions the symptoms of tomato-mosaic become less pronounced and sometimes late-season infection is scarcely perceptible. Owing to the danger of masking of symptoms it is unwise to save seed from tomatoes growing in a crop where mosaic is present.

The Effect of Fertilizers on Tomato-mosaic.—It has been shown by Brewer, Kendrick, and Gardner (1926) and Volk (1931) that various fertilizers—nitrogenous, phosphatic, and potassic—have no appreciable effect on the symptoms of tomato-mosaic.

Resistant Varieties.—Attempts to find varieties of tomatoes resistant to mosaic have so far failed (Gardner and Kendrick, 1922 (*b*); Bewley, 1925).

Preventive Measures.

(1) Save seed only from crops entirely free from mosaic.

(2) Do not plant out infected seedlings.

(3) Inspect plants periodically and remove infected plants immediately.

(4) Once mosaic appears do not handle the plants more than absolutely necessary. If possible, allow a fortnight to elapse between prunings.

(5) If mosaic has become too prevalent to allow infected plants to be removed, always work with the healthy plants before touching the diseased.

(6) Do not touch healthy tomato plants after working with mosaic-infected tomato, tobacco, or Cape gooseberry plants without first thoroughly washing the hands with soap and running water.

(7) If a crop has shown infection, remove all plants, with roots attached, as soon as possible after the season is completed and burn them.

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Limited Use for Subterranean Clover.—Subterranean clover is particularly adapted for growing on light soils for the reason that such soils usually dry out badly in the late summer or early autumn, and as it is only an annual the original plant dies just about this time, but meantime it has produced seed which comes away as soon as the autumn rains occur. As soon as the small white flowers are formed they begin to turn their heads towards the soil, and the seed, having matured, is actually pushed into the soil. Thus its life's cycle is completed and the original plant dies. The planted seed re-establishes as soon as the soil is sufficiently moist. In such situations white clover may die out or at best remain in a very stunted non-producing form. Subterranean clover thus produces its maximum growth during late autumn or early winter and again during early spring until the dry weather sets in, so that if dependence is placed upon it one is left without any clover in the pasture for probably a few months during summer and autumn. This explains why it is generally recommended for light soils. There is no reason why subterranean clover would not do well on heavier land. As a matter of fact, it does well on good moist soil, but it is generally agreed that white clover is much superior on such land and provides feed much more uniformly throughout the year than subterranean clover. Subterranean clover very quickly establishes itself through reseeding, and within a few years usually becomes dominant in a pasture. One should not expect to kill out subterranean clover by heavy stocking for the reason already explained—*i.e.*, the flowers are not prominent and the majority succeed in reaching the soil-surface and planting their seed in spite of stocking.

PIG-MANAGEMENT AND ITS RELATION TO DISEASE.*

* Portion of an address broadcast from radio station 2YA, Wellington, April, 1934.

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IN view of the increasing importance of pig-raising in New Zealand, there appears need for greater attention to methods of feeding and management.

In the Waikato district during several seasons in which there have been numerous opportunities of investigating disease and losses amongst swine it has been found that in many cases these can be ascribed largely to defects in feeding, and more particularly to neglect of certain elementary principles of management. Too often, in an attempt to increase production, the pig population on the farm has been increased by several sows, and later, by their progeny, while the original sties, contaminated and often out of date, and dirty yards, continue to do duty.

Some old-established pig feeders and breeders have undoubtedly developed an efficient system providing for clean runs and sufficient scope for their pigs, as well as feeding methods which prove satisfactory. Under these conditions there is usually almost complete freedom from disease. In far too many other instances, however, available knowledge appears to have been overlooked or ignored. Advice is sought after considerable loss has occurred, and it is frequently found that pigs are being kept under such conditions as to make disease almost inevitable. In such cases the first step to be taken towards improvement is to provide entirely new runs. Swine-fever, which had not been present in New Zealand for a long period prior to last year's outbreak in the Wellington Province, was effectually stamped out in May. With this exception, most losses are from bacterial causes, becoming active only when the pig's resistance and vitality are lowered.

FACTORS AFFECTING VITALITY.

Among factors tending to reduce vitality may be enumerated :—

Overcrowding.—This leads to jostling and fighting at feeding-times, with production of small wounds about the feet and elsewhere ; and also to too many pigs sleeping in one house, rendering it stuffy ; likewise to heavier dung contamination of yards, and more rapid cutting-up of surface in bad weather.

Dirt.—Mud and filth in yards and round feeding-places is soon contaminated by droppings, possibly from diseased pigs, and hence by germs and by eggs of parasites. The filth is necessarily carried into troughs by pigs' feet, and is also in contact with any wound or sore. Dirty feeding-places are very undesirable. One often sees pigs with an excellent free range over grass paddocks, undoing much of the benefit of this by coming to a filthy and contaminated feeding-place. In hot weather pigs are anxious to wallow, and access for this purpose to dirty drains from cow-sheds or pigsties should not be allowed. Dirty yards especially are a menace to suckers and young weaners, as they will

succumb at this period (four to ten weeks) to conditions under which older pigs may remain healthy. It is therefore a mistake to allow sows with suckers to run about with others in a common yard, or to let weaners feed and mix indiscriminately with older pigs.

Damp or draughty sleeping-houses, or draughty sleeping-places under open-bottomed trees or hedges, may lead occasionally to lung trouble.

In the winter and spring a sudden drop in the temperature or exposure to cold winds has been followed by disease, indicating the need for adequate housing and protection from prevailing wind, particularly at this period.

A general point frequently and forcibly brought to notice is the importance of isolating fresh purchases for about ten days, so that any latent disease which develops and becomes evident as a result of temporarily upset caused by transport to and from sales, and possible changes of feed, may be confined to the newly purchased animals and not spread to the herd.

Feeding.—Feeding is a most important factor in maintaining disease-resistance in the pig as in other animals. One must consider the routine of feeding, including the amount and number of feeds per day, physical nature of the food, its chemical composition, completeness, and ability to meet the demands of the animals being fed—whether newly weaned rapidly growing slips, pregnant sows, or baconers. Freedom from irritating qualities likely to upset digestion either directly, or, in case of suckers, indirectly by way of the mother's milk, must be guarded against. One has seen a type of scours in piglets due almost certainly to rich young grass on which sows were grazing. It is proposed to discuss feeding somewhat briefly from the above aspects.

General Considerations about Feeding.

Food taken in should include the proper amounts of protein, carbohydrates, and fats, the requisite minerals and vitamins, and sufficient, but preferably not excess, water.

Proteins have a somewhat complex structure. They contain nitrogen, and are necessary for building up the tissues in growing animals and for repair of waste. During digestion the protein molecule is broken down into the constituent amino-acids. There are many of these, some being essential for life and growth. Though a food may be rich in protein it may not contain these amino-acids which are essential, and thus it is unsuitable as the sole source of protein. The importance of variety in the diet is thus seen. Milk contains over twenty amino-acids, and is believed to be a complete protein food This partly explains why the addition of even small amounts of milk to other diets for growing animals produces at times increased growth out of all proportion to extra amount of food.

Much of the protein of milk is removed in cheesemaking. Henry and Morrison give the comparative analyses as—

	Skim-milk.	Whey.
Protein	3·8 per cent.	0·8 per cent.
Fat	0·2 per cent.	0·3 per cent.
Sugar	5·2 per cent.	4·8 per cent.
Nitrogenous ratio ..	1 to 1·5	1 to 6·8

Skim-milk is a valuable article of the young pig's diet. It is questionable, however, whether feeding of unlimited amounts of skim-milk without supplement is a sound principle.

Sources of protein available for pig-feeding are: Skim-milk, meat and meat-meal, good-quality short-growing pasture, meals such as pea or bean meal.

Carbohydrates include starches and sugars (and also fibrous portions of grass and plant products generally — the former somewhat poorly digested by pigs). They produce energy for the work of the body, heat during cold weather, and any excess is stored up as fat. Carbohydrates are available to pigs in the form of starches in grains such as maize, pollard, and barley; in the roots such as potatoes and artichokes, &c.; and in the milk-sugar of milk and whey. A useful carbohydrate is molasses, which might with advantage be more often fed with skim-milk, since it counteracts constipation and, according to recent work by Dr. Cunningham, of the Wallaceville Veterinary Laboratory, contains a considerable amount of lime in a very assimilable form. Carbohydrate in excess may produce an unduly fat carcass. The type of food influences the nature of the fat.

Fats.—Fats are utilized in much the same way as carbohydrates. They produce proportionately more energy. They are present in seeds (*e.g.*, linseed), the butterfat in milk, in meat-meal as animal fat, in certain fish-oils. The last have undesirable odours which may be carried over into the body-fat of the pigs, and stored, producing taint. Taint, of course, may result from other objectionable foods such as rabbit-meat.

Minerals.—On normal feeding and with a free range pigs will probably obtain sufficient minerals, but with confinement and artificial feeding, unless the mineral content is considered and adjusted, there may be a shortage. According to investigators, those minerals most likely to be deficient are lime and phosphate, possibly salt and iron compounds. Sows' milk is much richer in lime than cows' milk. Orr estimated that a three months' old pig required $\frac{1}{3}$ oz. of lime per day. Sheehy estimated that if a pig receives half a gallon of separated milk per day lime need not be added. However, one has seen bone lesions in pigs where skim-milk in large amounts was being fed. For the proper absorption of the lime from the diet the presence of vitamin D is necessary, or else free exposure to the sunlight. Further, the lime and phosphate must be in reasonable proportion to each other. Failure to utilize lime from skim-milk, therefore, may be due to confinement from sunlight together with complete removal of all vitamin D with the butterfat. It would then seem advisable to include a certain amount of air-slaked burnt lime or finely ground carbonate in the diet, and to provide the requisite vitamin by free range in sunlight or by the addition to the food of cod-liver oil.

Phosphates are plentiful in cereal grains and in young pasture, but may be deficient in roots. In winter feeding on roots and meat-meal a certain amount of bone-meat should be added unless this is already present as meat and bone meal.

Iron deficiency, resulting in anæmia, has been reported in the United States of America and Britain to occur in suckers confined to

houses and rarely in those with free range. While access to soil may provide sufficient iron in many countries, we do know that there are parts of New Zealand, not yet all defined, where this might not apply. Therefore, the supply of a trace of iron in the form either of limonite or citrate of iron to small pigs seems advisable. Liver-meal or blood-meal would equally supply this mineral. Cows' milk contains only most minute traces of iron.

Salt is, we know, necessary, but pigs are, under certain conditions, susceptible to salt poisoning, and the method of supplying salt must be studied. About ¼ oz. daily is sufficient for a three-month pig, and it is probably better to supply this in solution in the slop feed rather than allow access to unlimited amount. Whey-fed pigs will get sufficient from the whey.

Iodine, though essential, is probably always present in sufficient amount. Sheehy and Senior, from their experiments, concluded it was unnecessary to supply additional iodine to pigs, though remarkable results have been reported as following regular dosage with it. It has been the writer's practice to advise iodine in small amounts to pregnant sows, particularly in the winter. Half an ounce of potassium iodide in 1 pint of water and one teaspoonful of this solution supplied in the sow's slop daily for about a month in the pregnant period will provide about 1½ grains a day, which should be ample.

Vitamins.—These are known as accessory food-factors. They are essential to life, but it has been considered that animals under ordinary conditions obtain ample. Two particularly concern us here: Vitamin A is found in butterfat, cod-liver oil, green vegetables, &c., and is necessary for growth and to protect against bacterial infection. In skim-milk much of this vitamin has been removed with the butterfat. To ensure adequate supply for young animals either some whole milk, fresh green vegetables (good grazing), or cod-liver oil should be supplied. Vitamin D, as previously mentioned, is concerned in the assimilation of minerals—*e.g.*, lime and phosphates. Free exposure to sunlight will largely replace the necessity for this vitamin in the food, since the animal can then manufacture its own. The value of sunlight may be much less than in the winter-time as it has been noted that the amount of both A and D in whole milk are much less in winter than in summer under ordinary conditions. Cod-liver oil cannot be used indiscriminately owing to the danger of taint in animals soon to be used for meat. In the case of pregnant sows and young pigs, or weaners, this does not apply. The use of small amounts, say ¼ oz. to ⅛ oz. daily, of cod-liver oil as a source of both vitamins A and D to pregnant sows in the winter and to early spring weaners seems advisable. This is followed in Swedish practice. Its use to similar stock later in the season would depend on the amount of young green feed and of sunlight available.

A word as to grazing. Good-quality short pasture, especially if containing clovers, is valuable feed for pigs It contains considerable protein, comparatively good amount of phosphate, and is a source of vitamin A. Information collected by Mr. Peirson, Recording Officer of the Waikato Pig Recording Club, showed that in 131 pigs in fifteen trials, with good grazing available, an average of 2½ lb. more increase in live weight was put on in fifty-six days with less milk and meal than in a comparable number with poorer grazing. In other words, 2,520

gallons of milk and 47 lb. of meal produced 100 lb. live-weight increase on good grazing, while on poor grazing 3,120 gallons of milk and 49 lb. of meal were required for 100 lb. live-weight increase. A run full of weeds, however, must not be regarded as "grazing," and cocksfoot or rye-grass 2 ft. high, while it may provide some shade and shelter, is not suitable as a food. Grass in runs, therefore, must be controlled either by sheep or yearling cattle, or by mowing. There is great tendency for the rye to become coarse and rank owing to heavy manuring, and lime should be applied frequently, while it may be necessary to take an occasional crop of roots off the area.

Summary.

Recommendations based on the facts discussed above may be summarized as follows:—

Provision of clean runs with grazing, changing locality from time to time, as necessary.

Avoidance of filth around feeding-places.

Provision of suitable houses or shelters, free from damp and draught.

Avoidance of overcrowding, particularly in houses or at feeding-places.

Provision of a balanced diet as varied as possible, and including a little bone-meal or lime, and green stuff.

In winter and early spring allowance of a little cod-liver oil to pregnant sows and young weaners.

Isolation of recent purchases for at least ten days.

SUPERPHOSPHATES AND CHEMICAL FERTILIZERS.

The statistics presented hereunder in connection with the superphosphate industry have been extracted from the *Monthly Abstract of Statistics*, and show that more activity was evidenced by this industry in 1932–33 than was the case in the two previous years. For the year 1932–33 eight works reported operations, as against seven in 1931–32. The total cost of materials used advanced by 29 per cent., and the total value of products rose by 25 per cent.

The following table gives an analysis of the quantities and cost of materials used during the last three years:—

	1930–31.	1931–32.	1932–33.
Quantities.			
	Tons.	Tons.	Tons.
Rock phosphate	141,686	139,544	185,658
Sulphur	24,846	25,022	35,265
Nitrate of soda	919	1,031	1,322
Potash	598	194	460
Total Cost.			
	£	£	£
Rock phosphate	369,511	379,770	471,311
Sulphur	160,080	175,378	272,947
Nitrate of soda	11,264	12,653	16,997
Potash	4,720	1,621	3,964
Other (including bags)	144,680	138,623	149,143
Totals	690,255	708,045	914,362

THE MISUSE OF LIME ON BUSH-SICK LANDS.

(Abstract.)

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THE field experiments in connection with bush sickness which were started over twenty years ago gave an emphatic negative answer to the question whether it was necessary to use lime on the pastures of coarse pumice soils of the type technically known as sandy silts and all coarser types. Not only was there no response by the pasture to lime applied as a top-dressing, but animals grazed on limed land became bush sick sooner than on land to which no treatment had been applied. This information has been disseminated by means of this *Journal* from 1912 down to the present day, and a warning is here repeated with the added authority of recent experiments with lime on a variety of soils. Mr. C. R. Taylor, Analyst's Assistant at Rotorua, as the result of his inquiries, reports that lime alone applied as a top-dressing for pumice soils produces a pasture more unpalatable and drier in appearance than that on the untreated plot, while generally speaking lime and superphosphate mixture gives an inferior result to that from superphosphate applied alone.

The experience of other countries is interesting in connection with the reliability of certain laboratory tests in indicating whether a soil requires lime or not. The New Zealand experience of the coarse pumice soils is that field experiments do not bear out the need for lime indicated by laboratory tests universally used to determine the amount of lime required and the amount of sourness or acidity present in the soil. The British experience is somewhat similar with regard to certain fertile soils in Wales, Scotland, and Northern Ireland. Here the soil particles are coarse and are more akin to the parent rock than are those of the mature type of soils found in England, and although laboratory tests for acidity and lime requirement show that lime is needed and that no carbonate of lime is present, applications of lime do not improve the crops.

The results of certain laboratory tests as correct guides to liming will therefore have to be neglected when certain soils are the subject of experiment. As it is feared that the results of these unsatisfactory methods in the hands of analysts inexperienced in pumice soils may lead to the giving of wrong advice to farmers, the warning *Do not lime the pasture of bush-sick pumice lands* is again issued.

ANALYSIS OF LIMING MATERIALS.

THE Chief Chemist advises that copies of a new form to be filled in by farmers submitting samples of limestone, ground lime, or other liming material for analysis may be obtained from the Fields Instructors in the various districts or from the Chief Chemist, General Post Office, Box 40, Wellington. One form should be filled in for each sample, except where several samples of limestone rock from the same farm are forwarded, when one form will generally suffice. In future, samples will be analysed (free of charge to *bona fide* farmers) only if taken in accordance with the instructions and accompanied by full particulars set out on form Ag. H./6 4

CERTIFICATION OF SEED POTATOES.

PROVISIONAL CERTIFICATES ISSUED FOR SEASON 1933–34.

PROVISIONAL certificates are issued with the object of affording growers some indication of the general standard of their crops and assisting them in the disposal of their seed. Certification tags to be attached to the sacks are issued later, provided that an officer of the Department of Agriculture inspects the graded seed potatoes and is satisfied that they are still of the same standard of purity and freedom from disease as was indicated by the field inspection.

Each crop has received a group number, which indicates as accurately as possible the merits of its produce for seed purposes in relation to the merits of the produce of the other provisionally certified crops of the same variety. Group 1 is the highest and Group 10 the lowest. The difference between any two consecutive groups is small, and in making comparisons the cost of seed and transport should receive consideration.

Crops are also divided into two classes—namely, (1) Certified "Mother" seed; (2) Certified Commercial seed. Areas sown with certified mother seed are eligible for entry into certification. Areas sown with certified commercial seed are not eligible for entry into certification, except in cases where the seed planted has been raised by the entrant (grower) himself. Growers who intend to purchase seed with the object of entering certification must therefore purchase certified mother seed.

LIST OF GROWERS.

Name and Address.	Group No.	Percentage of Foreign Varieties.	Area in Acres.
AUCKLANDER SHORT TOP.			
Mother Seed—			
Adams Bros., Sheffield	3	..	4
Armstrong, P. L., Fernside, Rangiora	3	..	5
Barnett, A., Leeston	2	..	2
Barnett, R., Dunsandel	3	..	4
Barratt, W. H., Springlands, Blenheim	3	0·4	3
Caldwell, G., R.M.D., Courtenay	1	..	1½
Carroll, A. D., R.M.D., Southbridge	1	..	6
Carroll, J., R.M.D., Southbridge	2	..	3
Cross, A. E., Pine Farm, Bennett's via Rangiora	1	..	1
Crump, F., R.M.D., Springston	2	..	3
Crozier, W. J., Mt. Hutt, R.M.D., Rakaia	2	..	2
Dyer, H., Southbrook	2	..	3
Government Pure Seed Station, Box 4, Lincoln	2	..	1
Ham, A., Grovetown, Blenheim	3	0·4	1
Hegan, J., and Son, Southbrook	3	1·2	5
Henderson, G., R.M.D., Courtenay (Line A)	2	0·6	1
Henderson, G., R.M.D., Courtenay (Line B)	3	0·6	2
Heron, F., R.M.D., Rangiora	3	0·8	15
Jellie, J., Russley Road, Fendalton, Christchurch	2	..	2
Kavanagh, D., 50 Ryan's Road, Riccarton, Christchurch	3	..	1
Kenyon, F., Mina, North Canterbury	1	..	1
Marshall, D., R.M.D., Leeston	3	0·2	5
Martin, W. E., R.M.D., Kaiapoi (Line A)	2	..	3
Martin, W. E., R.M.D., Kaiapoi (Line B)	3	..	7
Morgan, D., Cheviot, North Canterbury	2	..	5
McPhail, W. A., Mitcham, via Rakaia	3	0·3	3
Nicklaus, J. F., 104 Ryan's Road, Fendalton, Christchurch	3	..	1

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Percentage of Foreign Varieties.	Area in Acres.
AUCKLANDER SHORT TOP—*continued.*			
Mother Seed—continued—			
Oakley, W., R.M.D., Halkett	2	..	6
Oliver, W. R., Hororata	2	..	1
Petrie, H. H., R.M.D., Swannanoa (Line A) ..	2	0·3	4
Petrie, H. H., R.M.D., Swannanoa (Line B) ..	2	0·6	5
Petrie, J., jun., R.M.D., Swannanoa	2	..	9
Petrie, J., sen., R.M.D., Swannanoa	2	0·2	5
Poulton, A. D., R.M.D., West Eyreton	2	0·3	5
Prosser, L. W., R.M.D., Leeston	3	..	5
Rathgen, A. E., R.M.D., Leeston ..	3	..	5
Redmond, C., R.M.D., Kimberley	3	..	12
Roper, P. F., R.M.D., Halkett	2	..	3
Roper, R. S., R.M.D., Halkett	2	1·2	3
Royds, R. S., 12 Burnside Road, Fendalton, Christchurch	3	..	7
Ryan's Estate, R.M.D., Springston	3	..	3
Swanson, W., Selwyn	3	0·6	3
Thomas, J. W., Gray's Road, Fendalton, Christchurch	2	.	1
Westaway, R. J., R.M.D., Courtenay	3	0·6	6
Wolff, R. G., R.M.D., Horrelville	2	..	3
Wright, L. T., Annat	2	..	4
Commercial Seed—			
Adams, K. and R., Sheffield	5	..	4
Anderson's Estate, Ladbrook's	4	..	3
Berryman Bros., 88 Winter's Road, Papanui, Christchurch	6	..	3
Breitmeyer and McFarlane, Little River	4	..	3
Crawford, A. W., 140 Belfast Road, Belfast ..	4	..	3
Crawford, J. M., Belfast Road, Belfast	4	0·6	3
Eder, W., R.M.D., Sefton	6	..	15
Ferguson, J. W., R.M.D., Winchmore	6	0·1	2
Guthrie, W. R., 34 Guthrie's Road, Belfast ..	4	..	3
Gaffeney, Mrs. M. F., Temuka	6	0·6	1
Gray, J. L., St. Andrew's	6	..	3
Gray, R., St. Andrew's	4	..	6
Guy, T. A. and E. B., Yaldhurst	4	..	2
Haines, C., 108 Waimakariri Road, Christchurch ..	6	..	2
Kelleher, T., Pleasant Point, Timaru	6	..	4
King, W. H., Rosewill, R.D., Timaru	6	..	2
Martin, A., Box 42, Morven	5	..	4
Miller, G., Seadown, Timaru	4	..	1
Moore, H. S., Box 4, Kaiapoi (Line A)	4	..	4
Musgrove, G., Meadows, Washdyke	4	0·2	1
Musson, W., Rangiora	4	0·6	4
McCaw, W. T., Tycho, South Canterbury ..	4	..	2
McDermott, E. C., Spreydon	4	..	9
McKenzie, J. R., Yaldhurst	4	0·3	8
Nairn, G., R.M.D., Lakeside	7	0·3	3
Oliver, J. O. J., Temuka	6	..	1
Porter, E., St. Andrew's	5	..	3
Porter, E. G. Y., St. Andrew's	4	0·7	5
Rangiora High School, Rangiora (Line A) ..	6	..	1
Rangiora High School, Rangiora (Line B) ..	4	0·5	1
Rich, A. J., R.M.D., Kaiapoi	5	..	15
Schaffer, F. L., R.M.D., Springston	4	0·2	6
Seivwright, R. M., Meadows, Washdyke	4	0·3	3
Seyb, L., Washdyke, Timaru	6	..	2

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Percentage of Foreign Varieties.	Area in Acres.
AUCKLANDER SHORT TOP—*continued.*			
Commercial Seed—continued.			
Simpson, F. F., Morven (Line A)	7	..	2
Smith, E. A., R.M.D., Springston	5	1·8	25
Smith, G. G., R.M.D., Broadfields	4	0·5	2
Spillane, A., River Road, Temuka	7	..	1
Timaru Boys' High School, Timaru	7	..	2
Topham, J. W., Arowhenua, Temuka (Line A) ..	6	..	1
Topham, J. W., Arowhenua, Temuka (Line B) ..	6	..	1
Watson, R. G. and L. J., Springbank, R.M.D., Rangiora (Line A)	4	..	1
Watson, R. G. and L. J., Springbank, R.M.D., Rangiora (Line B)	6	0·6	2
Weeber, H., Englefield Road, Belfast	4	..	5
Wilson, M., R.M.D., Halkett	4	0·2	2
Wilson, W., 279 Lincoln Road, Halswell ..	4	..	3
DAKOTA.			
Mother Seed :—			
Adams Bros., Sheffield	6	..	1
Allen, A., R.M.D., Leeston	4	..	11
Bower, M. Spencer, "Claxby," Swannanoa ..	5	..	1½
Campion, C. A., Highbank, Methven (Line A) ..	6	..	7
Chambers, A. J., "Carberry," Weedon's	5	..	5
Chambers, L. J., "Carberry," Weedon's	4	..	2
Chambers, R., Rolleston	5	..	5
Crozier, W. J., Mount Hutt R.M.D., Rakaia ..	6	..	6
Gardiner, C., Mitcham, via Rakaia	5	..	4
Gardiner, O. J., Dunsandel	5	..	8
Good, A., 133 Matson's Road, Papanui, Christchurch	5	..	1½
Government Pure Seed Station, Box 4, Lincoln ..	3	..	2
Hill, L. F., R.M.D., Eiffelton	5	..	5
Johnston, H. W., Dunsandel	5	..	5
Johnston, R. H., Dunsandel	5	..	2
Jowers, G. C., R.M.D., Springston (Line B) ..	5	..	3
Kavanagh, D., 50 Ryan's Road, Riccarton, Christchurch	5	..	1
Kokay, S., Tuatapere	6	..	1
Marshall, D., R.M.D., Leeston	3	..	5
Morrish, F. E., Springston	6	..	3
McKenzie, J. R., Yaldhurst	5	..	5
McPhail, W. A., Mitcham, via Rakaia	6	0·4	10
Nicklaus, J. F., 104 Ryan's Road, Fendalton, Christchurch	6	..	1
Petrie, J., jun., R.M.D., Swannanoa	6	..	9
Petrie, J., sen., R.M.D., Swannanoa	6	..	5
Rolston, G., R.M.D., Weedon's, Courtenay ..	5	..	9
Royds, R S., 12 Burnside Road, Fendalton, Christchurch	4	..	1
Ryan's Estate, R.M.D., Springston	5	..	1
Seymour, J , Hawthornden Road, Christchurch ..	4	..	5
Shellock, W., R.M.D., Te Pirita, Rakaia	4	..	2
Steele, J., R.M.D., Kimberley (Line A)	5	..	1
Thomas, J W., Gray's Road, Fendalton, Christchurch	5	..	1
Tweedy, S., R.M.D., Dunsandel	6	..	7
Walker, C. E., R.M.D., West Melton	6	..	12
Wilson, M., R.M.D., Halkett	6	0·2	5
Wolff, R. G., R.M.D., Horrelville	6	..	5

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Percentage of Foreign Varieties.	Area in Acres.
DAKOTA—*continued.*			
Commercial Seed :—			
Anderson's Estate, Ladbrook's	7	..	2
Berry and Halliburton, 28 Dundas Street, Christchurch	8	..	5
Boag, R. A., R.M.D., Greendale	7	..	3
Burnett, J. N., Templeton	7	..	2
Burrowes, J., Mount Hutt R.M.D., Rakaia ..	8	..	11
Campbell, D., King Street, Rangiora	8	..	2
Carpenter, A. M. and F., Fernside, Rangiora ..	8	..	4
Cockburn, A., R.M.D., Courtenay	8	..	1
Crawford, A. W., 140 Belfast Road, Belfast ..	8	..	1
Cross, A. E., Pine Farm, Bennett's, via Rangiora ..	8	..	3
Cross, H. E., R.M.D., Weedon's, Courtenay ..	7	..	5
Cross, S., R.M.D., Weedon's (Line A)	8	..	1
Curragh, J., Templeton	7	..	2
Ellmers, J. W., Kaiapoi	7	..	2
Foster, T. C., Ladbrook's (Line B)	7	..	8
Foster, T. C., Ladbrook's (Line C)	7	0·3	7
Giles, N., Seadown, Timaru (Line A)	8	..	1
Giles, N., Seadown, Timaru (Line B)	7	..	2
Gray, R., St. Andrew's	7	..	3
Green, J., Gleniti, South Canterbury	8	..	1
Ham, A., Grovetown, Blenheim	7	0·4	1
Jowers, G. C., R.M.D., Springston (Line A) ..	8	..	2
King, W. H., Rosewill R.M.D., Timaru	7	..	1
Mee, J. P. D., Levels	7	..	1
Miller, G., Seadown, Timaru	7	..	1
McIntosh, H. J., Kaiapoi	7	..	4
Oakley, J. T., R.M.D., Eiffelton (Line A) ..	8	..	1½
Pannell, W. B., R.M.D., Rangiora	7	..	2
Philp, F., Seadown, Timaru	7	..	1
Robson, F. H., Box 22, Lincoln	7	..	8
Ryan, P. F., R.M.D., Springs-Weedon's	7	..	10
Scivwright, R. M., Meadows, Washdyke ..	8	..	1½
Skurr, J. E., Sheffield	8	..	1
Steele, J., R.M.D., Kimberley (Line B)	7	..	3
Stowell, D., St. Andrew's	7	..	4
Ward, W. J., Ohapi, Temuka	7	..	7
ARRAN CHIEF.			
Mother Seed :—			
Bennett, T. A., Te Tua, Southland	3	0·8	3
Griffin, J. G., Te Waewae, Southland	1	..	2
Hayman, Mrs. F., Willowbridge (Line D) ..	4	..	1
Henderson Bros., Otapiri R.M.D., Winton (Line A)	3	0·6	1
King, R. M., Box 102, Tuatapere	2	0·3	4
Knowler, C. E., Tuatapere	2	1·1	3
Knowler, H., Te Waewae, Southland	1	0·6	5
Knowler, H. C., Te Waewae, Southland	1	..	4
Mehrtens, L. C., Box 27, Tuatapere	1	..	1
McCarthy, E., Prebbleton	3	..	1
Poninghouse, W. L., Tai Tapu	4	..	1½
Robinson, R. G., Box 4, Papanui, Christchurch (Line A)	4	..	1
Robinson, R. G., Box 4, Papanui, Christchurch (Line B)	3	..	1
Saunders, E. E., Studholme Junction (Line C) ..	4	..	1
Teschner, C. A., Chatton Road, Gore	4	0·3	1
Wright, L. T., Annat (Line A)	4	..	11

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Percentage of Foreign Varieties.	Area in Acres.
ARRAN CHIEF—*continued.*			
Commercial Seed :—			
Barclay, G. M. M., Riverside Road, Waimate ..	6	..	6
Barnett, A. W., Box 2, Morven (Line A) ..	5	0·3	1
Barnett, A. W., Box 2, Morven (Line B) ..	6	..	4
Bell, J. F., Stirling (Line A)	5	1·6	5
Borstal Institute, Invercargill	5	1·0	6
Brown, A. F., 287 Withell's Road, Riccarton, Christchurch	5	..	2
Campbell Bros., Waituna, Waimate	5	..	2
Campbell, P., Studholme Junction	5	0·2	1
Cox, S., Box 9, Willowbridge (Line A)	5	..	2
Cox, S., Box 9, Willowbridge (Line B)	5	..	3
Fletcher, W. J., Willowbridge	7	..	3
Frazer Bros., Southbrook	5	..	1
Gray, J. L., St. Andrew's (Line A)	6	..	1½
Gray, J. L., St. Andrew's (Line B)	6	0·5	9
Harris, J., Meadows, Washdyke	6	..	1
Hayman, A. B., Willowbridge	5	..	3
Hayman, Mrs. F., Willowbridge (Line A) ..	5	..	8
Hayman, Mrs. F., Willowbridge (Line B) ..	5	..	5
Hayman, Mrs. F., Willowbridge (Line C) ..	5	..	2
Henderson Bros., Otapiri R.M.D., Winton (Line B)	5	0·3	1
Henshaw, F. J., Studholme Junction (Line A) ..	6	..	2
Hewson, R. W., Seadown, Timaru	6	..	3
Leathwick, A., Hunter R.M.D., Waimate (Line A)	6	..	1½
Leathwick, A., Hunter R.M.D., Waimate (Line B)	6	0·2	1½
Poulsen, C. H., Styx Nurseries, Tombs Road, Christchurch	5	..	1
Reid, W. P., Maheno, via Oamaru	6	0·7	4
Robinson, R. P., Waikuku (Line A)	5	..	1
Robinson, R. P., Waikuku (Line B)	6	..	2
Rollinson, F., and Sons, Studholme Junction (Line A)	7	..	6
Rollinson, F., and Sons, Studholme Junction (Line B)	6	..	6
Saunders, E. E., Studholme Junction (Line A) ..	5	..	4
Saunders, E. E., Studholme Junction (Line B) ..	5	..	4
Saunders, F. L., Studholme Junction (Line A) ..	5	..	5
Saunders, F. L., Studholme Junction (Line B) ..	5	..	4
Sides, G., Studholme Junction (Line A)	6	..	3
Sides, G., Studholme Junction (Line B)	6	..	2
Topham, J. W., Arowhenua, Temuka (Line A) ..	7	..	1
Topham, J. W., Arowhenua, Temuka (Line B) ..	7	..	1
Topham, J. W., Arowhenua, Temuka (Line C) ..	5	..	1
Wilson, D. B., Grassy Hills R.M.D., Waimate ..	5	..	1
Wilson, E. R., Junction Road, Waimate	7	..	3
ARRAN BANNER.			
Mother Seed :—			
Amyes, H. C., R.M.D., Annat	4	..	1
Burgess, D., West Plains, Invercargill	3	..	1½
Carr, C., R.M.D., Tuatapere-Pukemaori	2	..	1½
Cooper, J., Croydon Road, Gore	3	..	1
Government Pure Seed Station, Box 4, Lincoln ..	3	..	1½
Hellyer, F. E., Macandrew Bay, Dunedin ..	4	..	1
Henderson Bros., Otapiri R.M.D., Winton ..	3	..	1
Knowler, C. E., Tuatapere	2	0·3	1
Milburn, M., R.M.D., Wright's Bush - Gladfield ..	2	..	1
McAdam, H. M., R.M.D., Invercargill-Glencoe ..	2	..	1
MacAlister, J. G., Otapiri R.M.D., Winton ..	3	..	1
Oakley, W., R.M.D., Halkett	3	..	2

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Percentage of Foreign Varieties.	Area in Acres.
ARRAN BANNER—*continued.*			
Mother Seed—continued.			
Robinson, R. P., Waikuku	4	..	1
Sheddan, G. B., R.M.D., Invercargill-Otahuti	3	..	1
Wilson, C. H., Lorneville, Invercargill	1	..	1
Wright, L. T., Annat	3	..	7
Commercial Seed :—			
Bell, J. F., Stirling	7	..	1
Dyer, H., Southbrook	7	..	1
Guy, T. A. and E. B., Yaldhurst	7	..	4
Hayman, Mrs. F., Willowbridge	6	..	6
Henderson, G., R.M.D., Courtenay	7	..	1
Manson, D. J., Enfield, via Oamaru	7	..	1
McCarthy, E., Prebbleton	5	..	2
McNae, F., R.M.D., Courtenay (Line A)	6	0·5	4
McNae, F., R.M.D., Courtenay (Line B)	6	..	6
Payne, J., R.M.D., Courtenay	6	..	2
Penn, T. A., 154 Innes Road, Christchurch	7	..	1
Porter, E., St. Andrew's	6	..	3
Robson, F. H., Box 22, Lincoln	7	..	1½
Roper, P. F., R.M.D., Halkett	7	..	1
Steele, J., R.M.D., Kimberley	7	..	1
Woodfield, L. T., Albert Street, Invercargill	5	..	1
AUCKLANDER TALL TOP.			
Mother Seed :—			
Court, R. T., R.M.D., Swannanoa (Line C)	5	..	9
Cross, H. E., R.M.D., Weedon's-Courtenay	4	..	3
Eder, W., R.M.D., Sefton	4	..	1
Frost, C. H., P.O., Balcairn	3	..	5
Government Pure Seed Station, Box 4, Lincoln	3	..	½
Guy, T. A. and E. B., Yaldhurst	3	..	3
Steele, F., Fernside, Rangiora	5	..	3
Commercial Seed :—			
Beal, H. W., Eyreton R.M.D., Kaiapoi	6	..	4
Crawford, A. W., 140 Belfast Road, Belfast	7	..	4
Hawke, McK., Landsborough Road, Timaru	7	..	2
Hewson, R. H., Seadown, Timaru	7	..	1
Inch, E. J., Woodend Road, Rangiora	8	..	3
Miller, G., Seadown, Timaru	8	..	2
Seyb, L., Washdyke, Timaru (Line A)	7	..	1
Seyb, L., Washdyke, Timaru (Line B)	6	..	1
KING EDWARD.			
Mother Seed :—			
Anderson, A., Stirling (Line A)	3	..	1
Brown, A. F., 287 Withell's Road, Riccarton, Christchurch	2	..	1
Burgess, D., West Plains, Invercargill (Line A)	2	..	1
Burgess, D., West Plains, Invercargill (Line B)	3	..	1
Cox, S., Box 9, Willowbridge	3	..	1
Griffin, J. G., Te Waewae, Southland	3	..	2
Knowler, H. C., Te Waewae, Southland	2	..	1
Kokay, S., Tuatapere	3	0·3	6
Mehrtens, L. C., Box 27, Tuatapere	2	..	1
Milburn, M., R.M.D., Wright's Bush - Gladfield	3	..	1
Commercial Seed :—			
Anderson, A., Stirling (Line B)	4	..	4
Brown, W. E., Orepuki	4	0·3	2

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Percentage of Foreign Varieties.	Area in Acres.
KING EDWARD—*continued.*			
Commercial Seed—continued.			
Craig, G. H., Factory Road, Mosgiel	5	..	1
Gilchrist, P. P., 187 Tay Street, Invercargill ..	5	..	1
Wilkins, J. H., Milton	4	..	1
JERSEY BENNES			
Mother Seed :—			
Burgess, D., West Plains, Invercargill	2	..	1½
Milburn, M., R.M.D., Wright's Bush - Gladfield .	2	..	1
Penn, T. A., 154 Innes Road, Christchurch ..	2	..	1
Wilson Bros., Quarantine Island, Port Chalmers ..	2	..	1
Commercial Seed :—			
Craig, G. H., Factory Road, Mosgiel	4	..	1
Graham, J. W., Factory Road, Mosgiel	4	..	1
EARLY REGENT BOLTER.			
Mother Seed :—			
Oakley, W., R.M.D., Halkett	3	..	8
Pascoe, S., R.M.D., Halkett	3	..	3
Robinson, R. G., Box 4, Papanui	2	..	1
Commercial Seed :—			
Oakley, J. T., R.M.D., Eiffelton	5	..	4
EARLY ROSE.			
Mother Seed :—			
Burns, R. A. C., Te Pirita R.M.D., Rakaia ..	5	..	3
Caldwell, G., R.M.D., Courtenay	3	..	1
Shellock, W., Te Pirita R.M.D., Rakaia	4	..	1
Commercial Seed :—			
Weaver, J., Te Pirita R.M.D., Rakaia	7	..	3
EPICURE.			
Mother Seed :—			
Robinson, R. G., Box 4, Papanui	3	..	1
Shellock, W., Te Pirita R.M.D., Rakaia	4	..	4
Wright, L. T., Annat (Line B)	4	..	2
Commercial Seed :—			
Campbell, D., King Street, Rangiora	5	..	2
IRON DUKE.			
Commercial Seed :—			
Government Pure Seed Station, Box 4, Lincoln ..	6	..	1
Guy Bros., Springbank R.M.D., Rangiora ..	9	..	15
Herridge, F. G., Woodend	8	..	5
Penn, T. A., 154 Innes Road, Christchurch ..	6	..	1
BRESEE'S PROLIFIC.			
Commercial Seed :—			
Allen, A., R.M.D., Leeston	9	..	2
Marshall, D., R.M.D., Leeston	9	..	5
New Zealand Loan Co., Christchurch	9	0·2	3
GREAT SCOT.			
Mother Seed :—			
Wright, L. T., Annat	4	..	7
Wright, Q., Annat	3	..	2
Commercial Seed :—			
Government Pure Seed Station, Box 4, Lincoln ..	6	..	½

LIST OF GROWERS—*continued.*

Name and Address.	Group No.	Percentage of Foreign Varieties.	Area in Acres.
MAJESTIC.			
Mother Seed :—			
Cross, H. E., R.M.D., Weedon's - Courtenay ..	3	..	1
Penn, T. A., 154 Innes Road, Christchurch ..	4	..	1
Commercial Seed :—			
Oakley, J. T., R.M.D., Eiffelton	7	..	2
ROBIN ADAIR.			
Commercial Seed :—			
Jellie, J., Russley Road, Fendalton, Christchurch ..	6	..	1
Marshall, D., R.M.D., Leeston	8	0·2	2
Wright, Q., Annat	9	..	1
UP-TO-DATE.			
Commercial Seed :—			
Guy, T. A. and E.B., Yaldhurst	7	..	2
Kokay, S., Tuatapere	6	..	5
Steele, J., R.M.D., Kimberley	6	..	2
ALLY.			
Commercial Seed :—			
Government Pure Seed Station, Box 4, Lincoln ..	8	..	¼
Stalker, W., Box 25, Rangiora	8	..	2
ARRAN CONSUL.			
Mother Seed :—			
Government Pure Seed Station, Box 4, Lincoln ..	5	..	½
Commercial Seed :—			
Robinson, R. G., Box 4, Papanui	8	..	1
KERR'S PINK.			
Commercial Seed :—			
Government Pure Seed Station, Box 4, Lincoln ..	6	..	¼
Hayman, A. B., Willowbridge	6	..	1
EARLY REGENT.			
Mother Seed :—			
Government Pure Seed Station, Box 4, Lincoln ..	5	..	½

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 5th April to 17th May, 1934, include the following of agricultural interest :—

No. 69790 : Milking-machine installation ; R. F. Mehrtens. No. 69921 : Removing hair from animal-skins ; S. V. Burridge. No. 69970 : Cream-cooling device ; J. A. Parr. No. 70418 : Teat-cup ; L. A. Sheehan. No. 71441 : Milking-machine ; F. A. Stempa. No. 71562 : Mowing-machine ; M. A. Cheadle. No. 71631 : Harrow-tine ; A. S. Bevin. No. 71353 : Fungicide ; E. I. du Pont de Nemours and Co. No. 71605 : Removing wool from skins ; I. W. Archibald and T. S. Bull. No. 71746 : Milk-cooling ; A. M. L. Gjuteri and A. C. O. Treschow. No. 70120 : Hay-stacker ; R. P. Short. No. 71024 : Grass-cultivator : J. Macalister. No. 71875 : Cattle-bail ; J. Hope.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

PRODUCTION OF CLEAN MILK.

INFORMATION ISSUED TO REGISTERED DAIRYMEN.

The Live-stock Division.

CLEAN milk has been defined as "the normal secretion from the normal udder of a healthy cow, uncontaminated by extraneous influences."

There is universal agreement that milk as an article of food possesses a high nutritive value, more especially for use in infancy and childhood. In view of this fact milk producers and distributors should recognize readily the paramount importance of *clean* and safe milk, and be prepared to join in co-operative effort in the providing of a wholesome supply.

As the consumer becomes educated to demand cleaner milk so must the dairy-farmer prepare himself to meet that demand. By the production of cleaner milk not only will an important safeguard to the health of the community be provided, but the farmer will be in a position to offer a further guarantee regarding the keeping qualities of his product, with the possibility of advantage to himself by increased consumption, and a *better price for a better article*.

SOME ESSENTIALS OF CLEAN MILK PRODUCTION.

1. *Mentality.*—There is no doubt that the most important factor in the efficient production and handling of *clean* milk is the mentality of the individual concerned, who must realize that milk is easily spoiled by contamination with bacterial organisms and dirt not necessarily visible to the naked eye, and who must be determined to carry out the best-known methods of producing and handling milk on all occasions, often at hours of the day and under conditions which do not make it an easy task.

2. *Water-supply.*—The next important factor on the dairy-farm is an abundant supply of *clean* water, without which general cleanliness, proper drainage, and thorough cooling of milk is impossible.

3. *Cooling of Milk.*—It is generally recognized that one of the best methods for controlling bacterial activity in milk is the regulation of the temperature. Cooling of milk as rapidly as possible after it is drawn from the cow *increases the keeping qualities.* In New Zealand a regulation under the Dairy Industry Act, 1908, requires milk to be cooled, immediately after milking, to a temperature of not more than 65° F.

Up to the present the most practical and economical method of cooling is by allowing the milk to run over a large metal surface, on the other side of which cold water is circulating. The most efficient apparatus for this purpose is the vertical corrugated cooler.

4. *Boiling Water and Steam Sterilization.*—Adequate facilities must exist for the provision of an ample supply of *boiling water*, for the purpose of scalding all utensils, &c. Efficient washing of all utensils is essential for the production and handling of *clean* milk. As soon as they are finished with the utensils should first be rinsed thoroughly with cold water to avoid a film of coagulated milk forming on their surfaces. They then require scrubbing with hot water and soda, which removes all trace of milk, &c., which may still be adhering to them, and finally they should be thoroughly scalded with *boiling water.* After this process the utensils should be placed on a *clean* rack to dry, buckets, &c., to be inverted.

The most efficient method of cleaning utensils is one which sterilizes them and leaves them dry, and for this purpose steam is by far the most effective agent to use, but it must not be thought that washing can be dispensed with if steam for sterilization is available.

The late Dr. Stenhouse Williams and his colleagues at Reading showed by numerous experiments that steam was more effective and reliable than any practical method of chemical sterilization. It leaves the utensils in perfect order for their next use, without the slightest risk of tainting the milk.

It is a common mistake, however, to suppose that if steam is applied to a utensil, sterilization has taken place. There are two main points to be remembered if successful sterilization by steam is to be accomplished: (1) The right temperature must be maintained throughout the period during which sterilization is taking place, and (2) the steam shall be employed in sufficient quantity for a sufficient

length of time. The aim should be to keep the temperature of the steam at about 210° F. and be able to submit the utensils to its action for a period of not less than five minutes.

One method in use in many small dairies takes advantage of the ordinary copper. A hole is bored in the lid and a short spout inserted. A good fire under the copper and the water properly and continuously *boiling* sends a good jet of steam through the spout, over which cans, buckets, &c., can be inverted for the required period of time.

5. *The Milker.*—Milk only with *clean* dry hands. "Wet" milking is a dirty habit and quite unnecessary. If the cow's teats are sore, or if for any other reason lubrication is considered desirable, a thin smear of vaseline is all that is needed. Do not handle the milk or cows if you are suffering from or recently had any infectious disease. Remember the spread of human diseases through the agency of milk is a factor of greater significance than the direct transmission of infection from cattle. Hands and nails should be *clean*. Wear a *clean* overall during milking.

6. *The Cow.*—Keep the tail trimmed and the hair clipped round the flanks and udder. Wash the udder and teats before milking with *clean* water, and *clean* utensils provided for the purpose. Do not feed hay during milking; it creates dust. Milk a case of mammitis *last* into a vessel which is not used for dairy purposes, and which contains some disinfectant. Do not use milk from a cow not properly cleansed after calving. Reject the fore milk. The first jets of milk from the teat are generally fairly rich in bacteria. Report any suspicious cases of disease scheduled under the Stock Act, 1908, viz: Tuberculosis; actinomycosis (popularly termed "wooden tongue" or "lumpy jaw"); and any tumour formation.

9. *The Cow-shed.*—Keep cow-shed and dairy washed down after each milking, and yards and drains *clean* and free from accumulation of rubbish. Keep feeding-material as far away as possible from milking-shed and dairy. Keep the milking-stools and leg-ropes *clean*.

8. *Milk and Utensils.*—Keep dogs, cats, fowls, flies, &c., away from the milk. There is no doubt improvement would be effected by the use of covered buckets for milking, instead of the uncovered ones in vogue. Remove the milk from the cow-shed to the dairy immediately, and strain and cool. An efficient strainer is the "Ulax," but a fresh filter pad must be used for each milking.

9. *Milking-machines.*—The fact that the milking-machine, if not scrupulously *clean*, acts as a sort of microbial reservoir from which the milk is generously seeded as it passes through the pipes should be too well known to need stressing. The best method of cleaning milking-machines is described by Mr. J. W. Smith, of the Dairy Division, in the *New Zealand Journal of Agriculture*, from which the following extract is taken:—

"(1) Before milking draw cold water through all milk-tubes and the releaser, so as to prevent the adhesion of milk to the pipes, &c.

"(2) Immediately after milking wash all dirt off the outside of the teat-cups and rubbers; then draw through each set of teat-cups sufficient cold (or preferably warm) water to flush out the milk system. When drawing the water through the set farthest from the releaser insert a ball of horsehair in the end of the milk-pipe, to cause it to travel through the releaser with the water.

"(3) Next draw through each set of teat-cups *not less than 1 gallon of boiling water*, to which caustic soda has been added at the rate of 1 to 1½ teaspoonfuls per *4 gallons of boiling water*. Distribute the solution as evenly as possible through each set of teat-cups.

"(4) Immediately follow by flushing out the caustic-soda solution with 2 gallons of hot water or 1 gallon of boiling water for each set of teat-cups. The flushing with boiling water helps to dry the rubber and leaves the milk system dry and sweet.

"(5) Then remove or open the plug or flap from the releaser pipe to allow of free circulation of air.

"(6) Next clean the vacuum system in the same manner as the milk system, by drawing through first the caustic-soda solution, and next the boiling water which has been circulated through the milk system. Pay particular attention to the cleaning of the pipe connecting the releaser to the vacuum-tank, by flooding the releaser to cause the water to travel through to the vacuum-tank. This is important.

"(7) The engine can now be stopped. Disconnect the two long rubbers from downpipes and teat-cups, and hang in a clean, airy place out of the sun.

"(8) Next disconnect the releaser and wash, rinse, and place in a clean, dry, sunny place; then disconnect the top or bottom half of the vacuum-tank, and treat in a similar manner.

"To ensure effective cleaning by this method it is essential that it be carried out daily in the manner directed. The caustic-soda solution instantly removes the greasy coating left by the milk on the inner surface of the tubing, and the final flushing with boiling water ensures the removal of the caustic-soda solution. In a short time the inner surface of the rubbers, through the action of the caustic soda, will become coated with a hard, glasslike surface. If, however, the method is not carried out daily in the manner directed the grease will penetrate into the rubber, and it will then be necessary to revert to the use of spiral brushes, which in turn will damage the inner surface."

Finally, equally important is the safeguarding of milk from outside sources of contamination after it leaves the farm—during transit, in depots, in shops, and during distribution. This work requires unremitting care.

ARTIFICIAL FERTILIZERS CARRIED BY RAIL.

THE figures for artificial fertilizers carried by rail for the twelve months ended 31st March, 1934, are now available, and the Dominion total discloses a decrease of 61,217 tons as compared with the figures for the previous twelve months: the figures being respectively 1933–34, 552,233 tons; 1932–33, 613,450 tons. It is of interest to note that the tonnage is the lowest recorded since 1926–27, also that the past season's Dominion total is not greatly in excess of the North Island total of 531,307 tons for 1928–29.

Dominion figures, in tons, for the years 1926–27 to 1933–34 are as follows: 1926–27, 446,751; 1927–28, 588,459; 1928–29, 708,515; 1929–30, 691,604; 1930–31, 568,491; 1931–32, 570,144; 1932–33, 613,450; and 1933–34, 552,233.

The figures for the North and South Islands for the past three years are:—

	North Island. Tons.	South Island. Tons.
1931–32	435,237	134,907
1932–33	463,603	149,847
1933–34	394,156*	158,077*

* Approximate figures only.

In connection with the apparent consistent increase shown by the South Island figures it must be remembered that the 1933–34 tonnage is appreciably lower than the figures for any of the years 1928–29 to 1930–31. The tonnage carried in the South Island during the year 1929–30 was 213,860.

The railway figures cannot, of course, be accepted as indicating the quantities of fertilizers used by farmers, as the figures cover large quantities railed to manufacturing-works, which quantities are subsequently included in the outwards figures for these stations. Again, it is certain that fairly large quantities are railed to distributing centres and a portion at least rerailed to farmers. The figures over a number of year will indicate the trend in respect of the use of fertilizers, although, obviously, the figures for any particular year may not indicate definitely the position in that particular year.

The recommendations of the Conference held last January between representatives of the Breed Societies, the Royal Agricultural Society of England, and the Ministry of Agriculture in regard to the future arrangements for continuing the London Quarantine Station for exported stock have now been approved by the Government. These recommendations include the transfer of the actual administration of the Station from the Royal Agricultural Society to the Ministry as from 1st April, 1934, and certain increases in the fees charged in respect of animals entering the Station.

SEASONAL NOTES.

THE FARM.

Top-dressing.

In many important grass-farming districts it has been found by experience to be advantageous to top-dress in July. Where, as often is the case, it is desired to obtain additional feed as soon as possible, then ordinarily superphosphate should be used. Regularly in these notes the application of superphosphate and of other phosphates to grassland much earlier in the season has been recommended, but farmers who have not carried out enough top-dressing in the autumn would be wiser generally to top-dress in July or thereabouts than to omit top-dressing for the season.

If there is a prospect of a feed shortage in August and September, then top-dressing about mid-July with sulphate of ammonia may be advisable. It is impossible to tender definite advice on this matter, for much depends on how acute the need is for additional early feed and how, alternatively, it could be supplied—*e.g.*, what would be the cost of purchased roots, hay, &c., to replace the additional early feed that is expected to result from top-dressing with sulphate of ammonia. Should top-dressing with sulphate of ammonia be decided upon, then, if possible, well-drained pastures containing a good deal of rye-grass should be selected for the purpose. Coarse, dry herbage should be removed from them by suitable close even grazing, and they should be harrowed prior to the application of sulphate of ammonia, with which as a general rule superphosphate should be applied if the pasture has not been top-dressed relatively recently with a phosphatic fertilizer. It is usually inadvisable to apply a nitrogenous fertilizer such as sulphate of ammonia earlier than the middle of July; it appears not to be able to stimulate growth of plants which are dormant essentially because of a low soil temperature, and if a quickly acting nitrogenous fertilizer is applied to such plants its potential effect seems not merely to be deferred but to be wasted.

While soluble nitrogenous manures, such as sulphate of ammonia, may be expected to be of some service as emergency means of increasing the supply of early feed, it becomes especially advisable during times of low prices of farm produce to endeavour to assess the value of the additional early feed on the basis of produce prices. In such assessing it should be remembered that the influence of additional early feed may be felt long after the additional feed has been consumed. For instance, additional early feed might enable three more dairy cows to be carried during the critical late winter—early spring period—a result which would be reflected in the farm returns for months afterwards. There is considerable field evidence pointing to the conclusion that the repeated dressing of a pasture with sulphate of ammonia season after season may lead to appreciable injury to the sward. Hence the same pasture should not be repeatedly dressed with sulphate of ammonia to produce early feed.

Harrowing and Spelling of Pastures.

Grass-harrowing widely calls for attention in July even though considerable harrowing has been carried out earlier. Harrowing of pastures which have been stocked heavily in May or June with cattle or horses is as a rule particularly desirable. Harrowing is also likely to be useful on fields on which there still is matted or coarse growth some of which at times is left as a legacy from unchecked, matured, autumn growth.

When possible, it is often advisable to close in July well-drained, well-sheltered paddocks for the use later on of calving or lambing stock. Rye-grass is of particular value in such paddocks because of its habit of early growth.

Winter poaching of wet, soft paddocks at times causes substantial permanent damage; it leads not only to the burial and loss of valuable pasture plants, but also to the establishment of weeds such as thistles, rushes, buttercups, and daisies on the bare surfaces created by the trampling in of useful plants. Young pastures particularly are likely to be damaged by poaching, which is most serious on heavy types of soil. Not a great deal can be done relative to poaching of pastures beyond avoiding as far as possible the stocking of those portions of the farm which are most subject to poaching damage. With this in view it may at times be advisable to concentrate the feeding of stock on a worn-out pasture which it is planned soon to put under cultivation.

The Problem of Inferior Pastures.

Especially in the principal grass-farming districts, there has been evidence of a tendency to persevere with worn-out pastures, when at times the more profitable course would have been to turn them over, and this especially is so of those many farms on which there usually is scant provision of special feed for use during the critical seasons of low supplies of feed directly from pastures. It is realized that worn-out pastures can often be improved appreciably by judicious top-dressing, &c., but as a rule repairing of pastures is a relatively slow process, and, further, the amount of improvement possible, which is determined largely by the plants which are present at the outset, is at times not as great as is desirable. If a farmer is lacking the necessary equipment and handicapped in respect to matters of finance and labour, then he may be justified in repairing a pasture which otherwise should be ploughed under, but apart from such instances the case for the renewal instead of the repairing of worn-out pastures is a strong one; a process of pasture renewal not only can be accomplished quickly but gives an opportunity of establishing more valuable species and of using better strains that may not have been readily obtainable when the pasture was previously sown. In this connection it is well to remember that while inferior pastures are not always so because of the fertility and other conditions under which they occur, this is often the case. The possibility of pastures being inferior to their natural conditions warrants brief consideration; there may, for instance, be a rapid falling-off in the rye-grass content of a young pasture when the conditions are suitable for rye-grass. Such a falling-off may be due to the ravages of the grass-grub, or, as is more probable, to the use of an inferior strain of rye-grass, which naturally is not persistent even under conditions of high fertility. If a pasture is inferior essentially because of the adverse conditions under which it is growing, then when this pasture is broken up primarily to be replaced by an improved sward it should be borne in mind that the mere sowing of seed fitted to give a good pasture will not necessarily give that pasture. If improved fertility through such practices as top-dressing and drainage is needed, then until it receives attention the sowing of good seed will be to some extent futile. At times this seems to be completely ignored. For instance, a sward inferior because of deficiency in plant-food is broken up and arable crops which impoverish the soil are grown before the land is again sown in grass. Actually it is not reasonable to expect a permanent improved pasture until the fertility is made better than it was prior to the impoverishment by the exhausting crops. In such circumstances any cropping prior to the sowing of permanent pastures should tend to increase instead of to deplete soil fertility. Though this may seem obvious, it is ignored in those numerous instances in which such crops as oats, maize, and millet precede permanent pasture, especially if the fertility of the land tends to be below the requirements of the type of pasture sought; these crops as a rule reduce fertility, particularly when they are not consumed where they are grown. It seems clear that if land has been worn out to some extent by cropping prior to sowing of permanent pasture, then generally a liberal fertilizing in the infancy of the new pasture becomes particularly desirable.

Drainage.

In general, winter proves the most suitable season in which to attend to farm drainage. One of the most important matters to be kept in mind is that money may easily be spent unwisely on drainage—even on land requiring drainage—unless the work is planned and carried out properly. As each drainage proposition is likely to contain aspects peculiar to itself, those desiring detailed guidance should apply to local officers of the Fields Division. The following general statements seem worthy of mention, mainly because they are at times ignored. The drainage of wet spots in a field is often the most profitable type of drainage a farmer can undertake. In the drainage of isolated wet spots an endeavour should be made—particularly if tile drains are being employed—to locate the drain-lines so that the drains may serve as part of more thorough and comprehensive future work and probably be the basis of it. As a rule, the first few pounds spent on drainage return the greatest profit relatively. The first thing that should be studied in planning a drainage system is the source of the excessive amount of water—the possibility of cheap drainage of an area by preventing water reaching it instead of costly drainage by removal of water may be revealed. This is especially applicable to wet areas along hillsides or on foothills. Mole drainage, under suitable conditions for it, is likely to be especially attractive when the benefit it confers is considered in relation to the annual charge involved.

Apart from new drainage work, there is often need in July to do maintenance work in respect to existing drains, which at least should be inspected periodically to ensure that they are functioning continuously. Too often the outlets are allowed to remain choked. All indications of failure of drains or of want of drainage should be noted, the former with the object of bringing about free flow and the latter with the object of knowing how to carry out most efficiently any future drainage work.

General Cropping Work.

Pits, and especially trenches, could be employed effectively in ensilage much more generally than seems to be realized. Ordinarily they are more economical in respect both to labour and to wastage of material than are stacks, but the stack system of ensilage has definite merits and should be adopted if circumstances are not favourable to pits or trenches. Two matters which need attention in the construction of pits and trenches are convenience of location and the avoidance in the excavated space of corners, which militate against the desirably thorough packing of the material to be ensiled. The fact that a great number of trenches are being employed successfully in level fields is of assistance in securing convenience of location. Detailed information about trenches and pits is contained in this Department's Bulletin No. 146.

As a rule, seed-sowing in the latter part of June and in July should be avoided, but as spring oats and wheat are usually sown in August and September and barley in September and early October, all possible progress should be made with the tillage work in preparation for these cereals. Care should be taken, however, not to carry out tillage when the ground is so wet that injury to tilth results. When the ground clings freely to boots or implements, then cultivation, though urgent, should be deferred. At times ploughing of old pastures can be carried out safely when ploughing of adjacent land which has been cultivated recently would be injurious because of its wet condition.

The best returns from pastures are not obtained as a rule unless crops to serve as auxiliary sources of feed are suitably grown. One of the greatest weaknesses in New Zealand farming is that insufficient quantities of such crops are usually grown. The crops other than grass which are to be grown during the coming season should be decided upon without any great further

delay to allow of preparatory cultivation being initiated in good time. Crops which in view of their outstanding value as auxiliaries to pastures have been strangely neglected are mangels and lucerne.

If preparatory cultivation for lucerne is not already in progress, generally it should be commenced at an early date. The area of lucerne in New Zealand is growing steadily—the area cut for hay in the latest season for which figures are available (1932–33) was more than 8,000 acres greater than the corresponding area seven years earlier — and as New Zealand experience accumulates it confirms that of other countries by showing what a definite misconception it is to hold that lucerne is specially exacting in its requirements, and this misconception is largely the cause of lucerne not being as widely grown as its worth warrants. Detailed guidance regarding lucerne culture is contained in this Department's Bulletin No. 155 which is available for free distribution.

Crop Utilization.

Poor winter feeding of stock is a common and grevious weakness of New Zealand farming. The dairy cow and particularly the developing dairy heifer frequently are fed so poorly that their subsequent production suffers substantially, and, though it is difficult at this stage to remedy satisfactorily a weak position during this winter, everything possible should be done to do so, and the requirements of future winters should be kept in mind in considering the approaching cropping season.

Cereals sown in the autumn should be fed off before growth becomes too long. Chou moellier is generally in good condition for feeding in July and should be used then, for sometimes in August it develops a tendency to run to flower-stalks. The feeding of roots should be carried out widely. After swedes, carrots and mangels should be fed in the order named. The feeding of roots and silage together in considerable quantities should, when possible, be avoided; they are both relatively bulky, watery feed which tend to balance well with hay of good quality.

The Use of Silage.

The value of silage as a winter feed for cattle and sheep has been fully established by the results obtained by individual farmers throughout the Dominion, but occasionally mistakes in the feeding of silage arise from attributing to a given quantity of it a greater feeding-value, relative to a similar quantity of hay or roots, than it really possesses. The general position may be deduced from the following facts: (1) 1 lb. of grass silage equals in feeding-value approximately 2 lb. of roots; (2) 2½ lb. of grass silage equals in feeding-value 1 lb. of average good hay; (3) a typical satisfactory full-maintenance daily ration for a dry in-calf dairy cow is approximately 40 lb. mangels, together with 12 lb. of average hay.

Simple calculations disclose that 50 lb. of grass silage is the nutritive equivalent of this ration. Without any evidence of harm, quantities considerably in excess of this amount have been fed; but in practice it is seldom necessary for stock to subsist on silage alone, and so the question whether it is desirable for them to do so is not of much moment in practice. On many farms silage has served with success as the sole supplement to pastures during the winter and early-spring period of scant grass-growth. Whether greater success would have resulted from the use of other supplements such as hay in conjunction with the silage is a moot point.

The feeding-out of diseased swedes on land which will be sown in turnips, swedes, or rape after a season or so should be avoided, as it may readily lead to the land being contaminated with club-root.

—R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

Pruning Operations.

ADVANTAGE should be taken of every fine day to hurry on with the seasonal work. The late-autumn operations outlined in previous notes such as ploughing, draining, &c., should have been completed. The period of the year that is devoted to pruning is from June to about the end of July. This period is the dormant or resting season for deciduous trees, in so far as the leaves will have fallen, the sap become quiescent, and the whole tree-structure at rest. Many growers speak of the sap as being down during the dormant season and coming up or rising in the spring-time. Apparently they believe that the sap flows to the roots in the autumn and returns to the branches, &c., in the spring. This is quite erroneous, however: the sap is simply more or less stationary during the colder period and with the return of spring becomes active again. Pruning is an orchard practice which should be undertaken only by experienced persons, while beginners wishing to become qualified pruners should be under supervision. The main object of pruning changes with the development of the tree. For the first four or five years after planting the aim is to establish a strong, healthy rooting system as well as to develop the framework of the tree. For the next few years, whilst the tree continues to develop, an endeavour should be made to induce fruit-production. Once this desired result has been accomplished, the maintenance of growth and prevention of over-cropping become of primary importance; at the same time it is necessary to ensure sufficient vigour for the maintenance of a healthy tree capable of producing an annual crop of first-grade fruit throughout a long life. When pruning, the operator must at all times bear in mind the importance of building or growing a tree with sturdy leaders and subleaders. These should be spaced evenly all round at a distance of at least 2 ft. apart. These leaders and subleaders forming the frame of the tree should be arranged so as to form an oblique angle from the trunk or stem. In this way the desired tree with an open centre is developed. An open centre not only exposes the inside of the tree to the sunlight which is so essential for the development and ripening of buds, wood, and fruit, but facilitates spraying and other cultural operations.

Once the frame of the tree has been developed (say, from six to nine years after planting), the following rules (which appear to operate almost invariably in the growth of plants), if observed, will be of great assistance to the operator when pruning:—

1. The vigour of a plant or of a shoot is dependent on the leaf surface upon it.

2. The nearer a shoot approaches a vertical position the stronger is the growth.

3. The nearer a shoot approaches a horizontal position the more its vigour diminishes.

4. The topmost shoots absorb most sap and outgrow those below.

5. Retarding the sap-flow operates against heavy growth; as a result of it fruit-buds develop. (This is achieved by very light or no pruning.)

6. Severe pruning increases the sap-flow, which in turn induces heavy wood-growth unfavourable for fruit-bud development. Each tree has its own individuality and should be pruned accordingly—*e.g.*, vigorously growing trees should be pruned comparatively lightly so as to steady the growth and leave ample wood for the development of fruit-spurs and lateral growths, and weakly growing trees should be pruned more severely with a view to promoting growth.

The leaders should be defined by cutting out strong competing growths that usually occur near the top of the tree. The leader itself should be shortened back (according to its vigour) to a bud pointing

in the direction in which growth is required, usually an outside bud. The foregoing remarks refer chiefly to apple and pear trees, but the general design of the tree as outlined is recommended for quince, apricot, peach, nectarine, and plum. The subsequent treatment of leaders of stone-fruits differs from that of pome fruits in so far as the leaders of stone-fruits should not be as clearly defined, and shortened back to the same extent as those on pome fruits.

The laterals are the greatest asset the tree possesses when viewed from a fruit-production point of view. Those of the current year's growth, if left intact, or lightly pruned, will form one or more fruit-buds, after which they may be shortened back to fruit-buds if desired. Very often the terminal bud of the current year's lateral will develop fruit during the following summer—for example, Irish Peach and Rome Beauty varieties. On the other hand, when the current year's lateral is shortened back, if the tree is at all vigorous, several new growths are formed and usually no fruit buds. The pruner should remove completely strong lateral growths, especially those in a vertical position, by cutting closely in to the main leaders or branches, leaving the weaker lateral growths for fruit-production. It may be necessary to remove some of the latter if crossing or over-crowding occurs. The centre of the trees should be kept open and not allowed to become overcrowded with unnecessary wood-growths.

The subsequent management of the fruit-spurs of stone-fruits differs in several points from that of pome fruits. In the latter, fruit-spurs require two or three years for their development, but when formed and matured they last with proper attention for a long period. In stone-fruit the fruit-spurs are of much quicker formation. The peach and nectarine bear fruit on one-year-old wood only. Japanese plums bear fruit on one-year-old wood and older, while the European plums produce fruit on two-year-old wood and older.

It is essential that the tools used for pruning be kept in good order, sharp and smooth, as a jagged or blunt blade often causes much damage by bruising the wood, which retards healing. All prunings should be gathered and destroyed by burning as soon as possible: the ashes can be returned to the orchard soil with beneficial results.

Grafting and Budding.

The scions for grafting should be selected at pruning-time from trees of known bearing habits, the wood should be well ripened, free from pests and diseases and should be of the past year's growth. As the scions will not be required for some time, they may be kept in good condition by burying the ends about 4 in. in the ground in a shady position. It is advisable to delay heading back the stocks until just prior to inserting the scion, otherwise a fresh cut is necessary. Stone-fruits to be budded should now be cut back so as to induce suitable growth for budding into.

Wounds and Wound Treatment.

Pruning of any kind causes a wound. The small sappy growths, however, quickly callus over without special attention provided the instrument used for pruning is sharp, clean, and smooth. On the other hand, when it is necessary to employ a saw (even a sharp saw) for the removal of larger branches the resultant wound will be jagged, and, if left untreated, not only will the cambium layer be prevented from functioning (by forming callus, thus healing over the wound) but an opening will be left for pests and diseases to make their entrance. In addition this introduces the risk of decay setting in. To treat such wounds, it is advisable to carefully trim the jagged edges of the bark with a sharp knife, leaving a finish with a bevelled edge, and to paint over with coal tar.

—J. W. Whelan, Orchard Instructor, Palmerston North.

Citrus Notes.

The next few months will be rather an anxious time for citrus growers in localities where frosts are likely to occur. There are few places in the Auckland Province where frosts are unknown during the winter months. However, in certain favoured situations, little, if any, damage is done to citrus trees. There are, however, some orchards in which a good deal of damage is likely to take place, not only to the trees, but to the fruit itself, unless preventive measures are adopted. Growers whose orchards are subject to injury due to frost should consider the advisability of protecting their trees by one of the methods which have been described in these notes from time to time. A certain amount of time, labour, and expense is involved, but the grower is usually amply repaid for all this, and, moreover, has the satisfaction of knowing that in addition to saving his present crop, he has also preserved his trees from injury which might be the means of reducing his crop the following year. Frost damage is most assuredly reflected in partial loss of the following season's yield. Every grower seeks the maximum yield of fruit from his trees; therefore nothing should be left undone that will prevent loss in future crops.

While the fruit of the orange-tree is often damaged by frost, the wood itself is not so liable to injury as that of the lemon. The wood-growth of the orange ceases much earlier in the season, and therefore has a chance to harden before the winter frosts occur.

Growers are urged again not to market oranges or lemons that have been affected by frost, as such a practice would depreciate the value of consignments, and would destroy the confidence of the consumer in New-Zealand-grown citrus fruit, confidence which has been established only after many years of perseverance, labour, and expense. If confidence were lost, it might be even more difficult to restore it than it has been to establish it in the local-grown fruit.

Where new plantings are contemplated, every care should be taken to see that suitable conditions are provided for citrus trees in respect to shelter, preparation of the soil, and the selection of healthy, well-grown trees. Unless these obtain it is far better to defer planting until such time as conditions are favourable. Where young trees are planted out in exposed positions, and, moreover, in poorly prepared soil, they often receive a set-back from which they seldom satisfactorily recover.

—L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

Seasonable Reminders.

AUGUST and September are the principal months for hatching-out chickens, so that no time should now be lost in mating the breeding-pens. It is always advisable to have the birds mated well ahead so that they may be suitably settled down before eggs are required for hatching purposes. There are no chicks that do so well as those brought out just after the days commence to lengthen, and are well settled down before the hot trying summer conditions prevail. Breeders would be well advised to study the notes which appeared in recent issues of the *Journal* on selecting the breeding-hens according to form. In these notes breeders were advised to select the required hens—the late moulters—for this season's breeding-pens before the moulting process sets in, for it is only then that the best specimens for breeding can be determined. Where the timely advice was acted upon and the late moulters and the best breeding-types were selected and marked accordingly, say, late in March, the work of mating will now be a simple matter. It is possible that, owing to their having developed some weakness, odd birds may have to be discarded in the final selection, but, generally speaking, where the work has been carried out by an experienced person, the remaining birds will be the select of the flock from almost any standpoint.

On plants where these important matters have been neglected till now it is difficult to estimate what loss may result eventually. For example, with the great majority of the hens now moulting, it is almost an impossible task to separate the desirable breeding specimens from those that are lacking in breeding-power. This being so, probably weak specimens will be used in the breeding-pen and these are almost sure to produce unprofitable progeny. While late moulting can generally be accepted as indicating good productive power, it is not to be inferred that all late moulters are suitable specimens for the breeding-pens. If a uniform flock is to be built up and maintained, something more is required, and if this result is to be achieved the breeder must have an ideal type in his eye, and keep this always in view remembering all the time that constitutional vigour forms the basis of all successful breeding operations. The usual signposts to these essential requirements are a " clean " face, clear bright prominent eyes, short shanks set wide apart, well-developed crop, tight thick feathering, and generally an active alert appearance.

In a general way, the qualifications to be looked for in a good breeding male, as indicating constitutional vigour and breeding-power, are generally similar to those required in the breeding-hen, excepting, of course, the natural sex differences. While feminine characteristics should be looked for in the female, the male should be practically at the other extreme. The head should be masculine in every respect, but without coarseness.

The Need to prepare now for Autumn and Winter Eggs.

The egg-market is now declining and many poultry-keepers are asking themselves why their hens commence laying only in the falling market. Such men have merely failed to strike the keynote of success—*i.e.*, hatching and rearing the chicks required at the right time and rearing them in such a manner that they will commence to lay at the commencement of the dear season rather than at the end of it. If everybody could breed to have birds laying during the late autumn and winter, eggs would be cheap instead of dear at these seasons. The fact that during recent months fresh eggs have commanded more than double the price of those produced during the season of greatest supply indicates how many producers there are out of the 154,000 poultry-keepers in the Dominion who fail to secure eggs when high prices rule. Obviously there can be no comparison made as regards profit between a bird laying the bulk of her eggs during the dear season and one producing her main yield in the cheap season, when almost any sort of fowl will lay. The poultry-keeper who succeeds in obtaining a high winter egg yield leaves nothing to chance. He realizes that winter eggs are an artificial production, and that artificial methods must be used to secure them. The production of eggs in the spring and summer months, when not only domesticated hens but the birds of the air breed and lay naturally, is a simple matter, but when a bird is expected to lay in winter it is entirely different. Everything must be done in a proper manner and at the right time. Those poultry-keepers who have failed to secure high-priced eggs in the past and who desire to obtain them during the next dear season must prepare for them now. Pullets must be depended upon, they must be hatched out at the right time, and, further, they must be well fed and managed throughout. The breeding-birds should be mated at once if this has not already been done, in order that fertile eggs may be available for hatching purposes during August and September. If the first chickens are hatched early in August they will commence to lay when the majority of the adult stock are terminating their laying-season, and at a time when egg prices commence to rise, although it is true that some of the first hatched pullets will moult in the early autumn and there will be a loss of winter eggs. But on well-managed plants there should be later hatched birds specially bred for laying during the cold months of the year. In any case, it would be an exceptionally small flock where all the early hatched birds moulted and ceased to lay at exactly the same time. Obviously some birds will moult earlier than others, so that when the latter are moulting

the former will have renewed their feathers and be ready to resume laying.

While it is not advisable to breed from pullets if hens can be obtained, the fact remains that on most plants there will be insufficient adult birds in the necessary productive condition to enable a desired number of chicks to be hatched during the early season, so that breeding from pullets must be resorted to. Where it is necessary to use pullets, they should be well matured birds that have been hatched in the early spring, and be the progeny of hens, not pullets. Care must be taken that they are mated not with a cockerel but with an adult male. It is far better to delay hatching operations than to breed from poorly-developed pullets or from ones from late hatches.

In the case of those who have to depend on the natural mother for hatching purposes, the difficulty of securing early chicks is realized, as at this period of the year broody hens are scarce, and, as a result, hatching operations are delayed beyond the most desirable season. Rather than delay on this account, however, the better plan is to resort to artificial methods by purchasing an incubator or by securing day-old chicks, or by obtaining pullets when about ten weeks old. The latter method as a means of overcoming the difficulty of securing broody hens when most required is an ideal one for the man in a small way, providing, of course, the young birds are purchased from a reliable breeder of stock of heavy production.

Management of Breeding Stock.

The management of the breeding-pens is a matter which demands much greater care than is usually given to it. It is a mistake to put too many hens with a rooster, just as it is to put too few. In closely confined quarters, not more than eight hens of the heavier breeds should be put with a male bird, and ten hens of the lighter breeds. On free range, which is most desirable for breeding-stock, the number of hens may be doubled. The diet is a most important item in breeding operations. The birds should be well fed on a plain diet, but on no account should high records in egg-yield be aimed at by feeding a heavy meat-ration, &c., or trouble will probably be met with in the hatching and rearing of the chicks. This is not to say that breeding-birds should be kept on a light ration, but rather that meat and similar forcing foods should be fed sparingly. The best plan is to supply at all times a mixture of any grains, such as wheat, maize, oats, &c. In fact, the greater the variety of grains fed the stronger will be the hatching qualities of the eggs and the easier will the chicks be to rear. If the birds are inclined to become too fat they should be encouraged to exercise by feeding the grain in deep litter. This is important, for a high percentage of fertile eggs containing strong germs cannot be expected from a hen that is over-fat.

It will be found usually that the most fertile eggs and the strongest chicks are produced from parents that have a free range, or are provided with large-sized runs. No doubt this is chiefly due to the variety of food picked up and the natural exercise which is taken by the birds in finding it, and which prevents them from putting on surplus fat. A necessary means of maintaining breeding-birds in good condition is to keep them well supplied with succulent green material.

The quarters should be kept in a sanitary state, and absolutely free from vermin. Especially does this apply to vermin such as red-mite, for a hen cannot produce good strong chicks if its life blood is being drawn away nightly by insect pests.

Too much care cannot be given to the breeding-birds. Much of the ill success met with in incubation, brooding, and rearing may be traced to mistakes made in the management of the breeding-pen. For instance, the male bird may be run down, and out of condition, or perhaps the hens are too fat and have insufficient exercise. It is a good plan to handle the male bird at night frequently, for he may be too attentive to the hens and

not be taking sufficient food, in which case it is impossible to get good results. If a male gets out of condition he should be replaced by another, and if this is not possible he should be fed at least once a day by himself.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

Winter Inspection.

THE management of the apiary at this season consists chiefly in making an occasional round among the bees to see whether everything is in good order. On no account should the bees be unnecessarily meddled with. Where any doubt exists as to the stores required for wintering it may be necessary to open the hives. However, it is by far the better practice to try to estimate the quantity of stores on hand by lifting the back of the hives. Experienced beekeepers can in this way gauge by weight the stores present. Inexperienced beekeepers, will, of course, have to examine the combs. If it is necessary to do so, it is advisable to choose a fine day, and in any manipulation that follows on no account to break up the cluster of bees. After examination, it is well to close up the colony as soon as possible in order to conserve the heat. If a colony is found deficient of stores, a comb or two of honey or a cake of candy laid on top of the frames over the cluster will help considerably. At this season of the year bees will not take syrup readily. If combs of honey are on hand and feeding is carried out the combs should be placed on the outside of the cluster. To place them in the centre of the cluster will be the means of dividing it, and this will result in much harm to the bees and probably bring about their death.

Mats and Covers.

After heavy rains it is well to examine the mats over the frames. If any damp ones are found, they should be replaced with dry ones. A supply of mats should always be on hand. It will be necessary only to gently lift one end of the cover to discover the condition of the mat, and this can be done without disturbing the bees.

All covers that are not absolutely rainproof should receive attention. No better covering for roofs can be had than sheet lead. Such covers are costly to commence with, but are rainproof and do not require to be secured in windy locations. If sheet lead is found too expensive, the roofs may be covered with zinc or ruberoid. If the latter material is used it should be heated before being fixed to the roofs.

Removing Spare Top Boxes.

All the top boxes that have not yet been removed should now be taken off and the bees confined to the brood-chambers. Breeding will commence shortly in colonies of normal strength in the warmer parts of the Dominion, and the hives should be made snug with well-fitting mats to conserve the heat of the hives. If it is found that the bees occupy only a top box, remove the lower one, and put the former in its place.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Vegetable Seeds.

VEGETABLE seeds rarely fail to grow, but it is not uncommon to find one has sown them too thickly, not an inconsiderable waste so far as the more expensive kinds are concerned. In addition there is the further cost of thinning out the seedlings—a tedious job demanding great care. Other kinds of seeds may be sown, at what might be considered about the same rate, and the result is a thin crop. By studying the vitality and life of

seeds under normal conditions, the mistakes above mentioned, and some others, will be avoided, and better crops will be obtained at less expense. The following table has been compiled with a view to supplying some of the more important facts which will assist one to obtain good results :—

Vegetable Seed.	Average Germination.	Life of Stored Seed in Years.	Seeds required for 100 ft. Drill.
	Per Cent.		
Asparagus ..	85	5	1 oz.
Beans (dwarf)	94	3	1 pint.
Beet	90	6	2 oz.
Cabbage	90	5	¼ oz.
Carrot	80	4	1 oz.
Cauliflower	80	5	¼ oz.
Celery	82	8	¼ oz.
Corn—sweet	94	2	¼ pint.
Leek	88	2	½ oz.
Lettuce	94	5	½ oz.
Onion	88	2	1 oz.
Parsley	75	3	¼ oz.
Parsnip	80	2	½ oz.
Peas	94	3	1 pint.
Radish	94	5	1 oz.
Spinach	85	5	1 oz.
Tomato	90	4	⅛ oz.
Turnip	94	5	½ oz.

The percentage of germination of a parcel of seeds will depend on its age and the conditions under which it was grown, harvested, and stored. In addition the natural vitality of the different kinds of seeds varies. The table shows such kinds as dwarf beans, lettuce, peas, radish, turnips, &c., to have high standard of germination generally, while carrot, cauliflower, parsley, parsnip, &c., have a comparatively low average germination percentage. If sowing is therefore adjusted accordingly, one can secure some of the benefits referred to above.

Economy may be obtained also by studying the column under the heading of the life of stored vegetable-seeds. The table gives a moderate estimate of the life of the seeds of long-lived kinds, but the figures regarding short-lived seeds, such as onion, parsley, and parsnip, should be taken as the limit for those kinds under ordinary conditions, and for best results new one-year seed should be used.

The time taken for vegetable-seeds to germinate varies widely : lettuce, radish, and turnip seeds are usually up in a week, while carrot, celery, and parsnips generally take from two to three weeks before making an appearance ; other kinds take about seven to fourteen days. For this reason, on land inclined to be weedy, it is sometimes convenient to sow a small quantity of radish-seed with the parsnip-seed so that the drills are indicated quickly, and hoeing, for the suppression of weeds, can be done without risk of injuring the crop.

Another important fact regarding vegetable-seeds is the type and strain of the plant they produce. Under natural conditions the original plant-type was comparatively consistent from year to year. The greatly improved types of the different kinds of vegetables that have been produced are maintained only by the most careful selection of seed-plants each year. The constant tendency is for such annual crops to revert to the wild type ; this is prevented only by removing before seeding commences plants showing such a tendency. It is the annual work of " rogueing," demanding so much time, patience, and skill, that makes seeds of high strain expensive.

This should always be remembered when purchasing seeds. By omitting the expensive operation of "rogueing" a much larger crop of seed would often be obtained with probably a high percentage of germination, but the quality would fall.

Considering the long life of most seeds and their value, they should be stored with great care; vermin, moisture, and heating are perhaps the greatest dangers. Mice, weevils, and other pests come under the first heading: these can be avoided by storing in clean, substantial structures free from infection. Seeds poorly harvested and cured are most likely to generate heat when stacked closely, particularly in poorly ventilated conditions. For this reason metal or glass containers are often unsatisfactory. Such vessels are an excellent safeguard against vermin only. Conditions generally most suitable for seeds of the class just mentioned are dry and well-ventilated, with a moderately warm even temperature. For convenience the seeds may be kept in secure stout-paper packets with name and date on the outside, or in linen bags with the identification label attached, in addition to another in the bag amongst the seed in case of accidents. These parcels may be stored in pigeonholes or in the drawers of a wooden cabinet. Obviously good seed in sound condition is a prime factor in satisfactory cropping.

Vegetable Crops.

Potatoes stored in the dark at ordinary temperatures, especially where ventilation is poor, will at this season send out long white sprouts that will badly depreciate the seed. For this reason seed potatoes should now be stacked in an open manner in an airy shed that is light and cool. They should be turned occasionally if they are in sacks and there is any sign of dampness. Sprouting the seed of early kinds in trays is quite a good practice. Under the conditions recommended short sturdy shoots are developed and these enable the seed potatoes to become established quickly when weather conditions permit them to be planted out. On light soils in warm localities this may occur towards the end of the month of July. Planting and sowing any crop, at this season, should be done only when the soil is dry and friable. One should be ready to take the opportunity as it arises, but it is a fatal mistake to plant or sow, at this season especially, land that is in the slightest degree what one might call wet.

Autumn-sown onions may be planted out, under proper conditions, in land that is rich, light, and well consolidated: it is advisable to trim off the tops and straggling roots of the young plants and to dibble them in about 6 in. apart in the rows. Garlic, shallots, and chives are vegetables of the same class which may be planted now. Chives is a perennial herb of mild onion flavour, and from it supplies may be obtained at any season. It requires but little attention and is very suitable for planting in the vicinity of week-end cottages or out-of-the-way places. Shallots are mild, excellent for sauces or pickles, and easily grown. Such crops planted now have a particular value in the warmer and more humid districts, as they ripen at mid-summer, when harvesting and proper curing may be done most satisfactorily and with least risk from disease.

Towards the end of the month of July, weather permitting, cabbage and cauliflower plants may be set out—also new plantings of rhubarb. Early peas, broad beans, artichokes, lettuce, spinach, and radish may be sown.

Small-fruit Crops.

When the soil is in condition plant out new brakes of bush fruits for which adequate preparation has been made. The exposure of the roots to wind and sun should be avoided, and the plants should be set firmly at the right depth after trimming away straggling roots and tops. When planting is completed, it is well to go through the crop and to prune

carefully each plant. Some inter-cropping with vegetables may be done in the first season; but the welfare of the permanent crop should be given first consideration.

The Tomato Crop under Glass.

In preparation for setting out the plants towards the end of July or August, it is advisable to broadcast and to fork in such fertilizers as may be necessary a few weeks before planting. With a sufficient supply of humus present in the soil, the dressing usually consists of phosphates and potash, and where the drainage is doubtful or the soil is naturally heavy, finely-ground carbonate of lime may also be included: 3 oz. finely-ground bondust and 2 oz. each of superphosphate and sulphate of potash per square yard form a good fair dressing at this stage under ordinary conditions. Although the house may now be empty, it is an advantage to maintain a warm fresh atmosphere in preparation for planting; allowing the air to become over-heated will dry out the soil to an extent which is undesirable.

A week or so before planting out it is advisable to place the plants in the house to harden off and to accommodate themselves to the new conditions. They should be planted firmly, rather deeply, and in a shallow trench. There is a tendency to crowd the plants together, which is very unwise, as it is the cause of much disease, especially in humid localities. The plant demands a dry, buoyant atmosphere to keep it in condition, and that can be secured in summer only by now setting the plants sufficiently far part—not less than 24 in. between rows and 12 in. between plants, with rather more space between the rows in districts where leaf-mould is very troublesome.

The Homestead Garden.

The busiest season in the garden now commences: first where the soil is light and warm—on heavy soils rather later. Old lawns may now be reconditioned or new ones laid. Plants in the herbaceous border may be lifted and set out, carefully labelled, in nursery rows in the kitchen garden while the border is being trenched, manured, and put in good order with an even surface at the right level for replanting. Meanwhile it is advisable to take the list of plants and to scale-plan the suggested new arrangement on graph paper; then, when the soil is in good condition, to place a numbered label in the ground each yard along the border front and back; then a garden-line or two from end to end dividing the border into yard-wide strips. The group outlines, as planned, may now be drawn on the ground and the drills filled with dry sand. Each space should be marked with a clearly-written label, and planting may be done, true to plan, as occasion permits. Let the herbaceous border be true to name; it might be made on the verge of shrubbery, but an evergreen hedge as back-ground is better. The only herbaceous plants in the shrubbery should be woodland plants quite at home under the conditions; few of our highly improved hydrids are of this nature; they require generous treatment that cannot be given in a shrubbery border.

In warm localities roses may be pruned, elsewhere such pruning is best left until the month of September, or young growth is apt to be destroyed by frost.

The removal and planting of trees and shrubs may be done when the land is in condition: generally it is best done now as soon conditions permit. The fine autumn-tinted foliage, and berry plants, seen on every hand, offer good suggestions for the planting-list; as do the fragrant daphne, *Chimonanthus fragrans*, and *Lonicera Standishii*, the "japonicas" (*Cydonia japonica*), camellias and wattle which, with others just as good, make the winter garden in these fortunate islands challenge the display of summer-time.

W. C. Hyde, Horticulturist, Wellington.

WEATHER RECORDS: MAY, 1934.

Dominion Meteorological Office.

NOTES FOR MAY.

THOUGH there were two rather severe storms during May, the weather for the greater part of the month was relatively quiet. Temperatures were, in the mean, considerably below normal, but there was only one really severe cold snap, that accompanying a southerly gale on the 17th to 18th.

Rainfall.—In much the greater part of the North Island the total rainfall was considerably below average, but small excesses were recorded in some areas around Auckland, in Southern Taranaki, and in Southern Wellington. In the South Island, the Nelson Province and Stewart Island had rather less than the average, but in the remainder it was a very wet month.

Temperatures were below average everywhere except in parts of Otago and Southland. The departures were rather large in the North Island. Frosts were rather numerous.

Pressure and Weather Systems.—The first event of meteorological importance in the month was the development of a remarkable cyclonic storm which reached its maximum intensity on the night of the 3rd. On the 2nd there was a trough of low pressure located west of New Zealand. It was not very deep, but it extended in almost a due north-and-south direction from north of Norfolk Island southward to beyond the region covered by our reports. It marked the boundary between warm air coming from the tropics and a colder mass lying to the west of it, which had a far southern origin. On the 2nd there was a small centre of low pressure in the above-mentioned trough situated in the neighbourhood of Norfolk Island, the lowest pressure being about 29·8 in. On the morning of the 3rd the storm centre had developed into a deep and full-fledged cyclone, the lowest pressure being near Cape Maria van Diemen and amounting to about 29·2 in. The southward movement was continued, and on the morning of the 4th the centre, where the pressure was now about 29·1 in., was near Wanganui. At this stage the storm was intensified through interaction with an older centre farther south. West of a line running from Russell through Wanganui, Wellington, and Christchurch, on down the east coast, was cold air moving from the south or southwest, while to the eastward was warm air moving at the speed of a gale from a northeasterly direction. Thus, at Akaroa a northeasterly gale was blowing, while at Christchurch there was a light southerly. This meant that the warm, moist air from the northeast was climbing rapidly up over the cold southerly, a condition ideal for the formation of heavy rain. And since the division-line between the two winds moved extremely slowly, the rain continued for a long time. This was the explanation of the extremely heavy rain which occurred on Banks Peninsula and the floods of record height which did so much damage at Little River and the surrounding district.

Another notable spell of stormy weather commenced on the 14th. From the 15th to the 17th most of the country, but especially the South Island, was afflicted with northwesterly or westerly gales. The spell concluded on the 17th to 18th with a southerly gale and a severe cold snap. Snow fell on the ranges in all parts of the country, and in Southland even the low levels were coated for a few hours. The high southerly winds caused further damage to trees, fences, &c. On the evening of the 17th a tornado, which was unusually severe for New Zealand, struck New Plymouth, partially wrecking a number of houses.

RAINFALL FOR MAY, 1934, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average May Rainfall.	Total for Year to Date.	Average for Year to Date.
	North Island.					
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	5·36	12	1·69	6·61	15·95	21·57
Russell	6·86	13	3·58	7·07	19·54	20·84
Whangarei	6·03	17	2·17	7·88	18·07	25·06
Auckland	5·60	18	2·50	4·64	20·33	17·04
Hamilton	5·93	12	1·68	4·70	15·49	18·79
Rotorua	4·07	12	2·23	5·71	17·91	21·62
Kawhia	5·45	15	1·07	5·34	12·21	19·82
New Plymouth ..	3·69	16	0·95	6·18	19·37	22·48
Riversdale, Inglewood ..	5·82	17	1·21	9·69	29·53	38·38
Whangamomona ..	8·93	13	2·75	6·84	28·81	27·81
Hawera	4·74	13	1·03	4·58	17·23	16·98
Tairua	3·64	9	2·10	7·08	19·44	26·59
Tauranga	4·05	12	2·30	5·12	21·38	21·46
Maraehako Stn., Opotiki	3·07	8	1·73	5·70	15·99	22·13
Gisborne	2·38	15	1·22	5·36	11·16	20·01
Taupo	3·71	12	2·24	3·95	17·21	16·80
Napier	1·30	11	0·33	3·64	13·44	15·26
Hastings	1·71	13	0·55	3·29	11·60	13·56
Whakarara Station ..	4·08	12	2·05	..	22·04	..
Taihape	2·89	18	0·64	3·46	13·71	14·25
Masterton	4·31	15	0·60	4·01	14·07	15·20
Patea	4·78	14	1·00	4·15	17·77	17·16
Wanganui	2·44	12	0·55	3·34	16·66	14·33
Foxton	2·21	10	0·70	3·19	12·82	11·88
Wellington	4·53	12	2·39	3·98	16·01	16·10
	South Island.					
Westport	5·85	19	1·08	8·35	40·38	37·65
Greymouth	7·25	18	1·35	8·10	37·04	40·76
Hokitika	6·49	16	2·00	9·61	39·02	45·84
Ross	12·36	15	3·39	9·83	55·10	54·04
Arthur's Pass	14·90	10	4·91	12·78	66·03	65·41
Okuru, South Westland	..	..	..	10·80	..	61·32
Collingwood	4·53	13	0·92	8·87	25·46	34·80
Nelson	1·95	9	0·56	3·31	11·12	14·77
Spring Creek, Blenheim	3·19	10	1·45	3·03	8·39	11·53
Hanmer Springs ..	7·89	14	3·27	4·50	28·53	18·12
Highfield, Waiau ..	4·80	10	1·91	3·25	19·49	14·27
Gore Bay	4·90	19	2·25	3·41	20·89	13·18
Christchurch	7·34	15	2·19	2·51	15·22	10·27
Timaru	2·48	7	1·14	1·46	14·63	9·36
Lambrook Station, Fairlie	4·29	8	2·68	1·57	15·39	10·12
Benmore Stn., Clearburn	3·01	10	0·75	1·79	11·86	10·99
Oamaru	2·91	8	0·97	1·60	11·29	9·00
Queenstown	4·54	15	1·45	2·54	14·87	12·99
Clyde	..	..	..	0·99	..	6·84
Dunedin	7·19	18	2·35	3·10	19·68	14·97
Wendon	3·45	13	0·54	1·98	14·68	12·89
Gore	..	..	..	2·56	..	14·66
Invercargill	5·70	22	0·83	4·31	19·49	19·45
Puysegur Point ..	6·07	25	1·10	6·67	28·98	35·67
Half-moon Bay ..	7·00	21	1·10	4·85	21·06	24·22

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

TREATMENT OF WEEDY LAWN.

M. W. H., Whakoangiangi :—

My lawn has a lot of daisy, rib-grass, and another very small-leafed weed that takes root at all joints, has a very strong smell, and is dense. What is the best way to clean the lawn ? In places I will need to fill up hollows with fresh earth.

The Fields Division :—

Daisies, rib-grass, and the strong-smelling dense weed, which is probably pennyroyal, are common weeds in many lawns. For autumn treatment it is advisable to first top-dress the lawn with a mixture of equal parts of superphosphate and nitrate of soda at the rate of 1 oz. per square yard from two to four weeks before treatment for the eradication of weeds. To eradicate the weed growth spray the lawn with one part arsenic pentoxide to eighty parts of water. Care should be taken not to saturate the lawn heavily, but merely to damp all vegetation, otherwise the grass may be burned too severely. At the season of the year when growth is very vigorous the strength of the spray may be increased to one of arsenic pentoxide to sixty parts of water. In the following spring if a few weeds remain the lawn should be again sprayed lightly, and about September it should be scratched with a sharp-toothed garden rake and any holes or bare patches levelled up with good clean soil free from weed-seeds and sown fairly heavily with a mixture of Chewings fescue and brown-top. Do not roll. Until the young grass in the sown patches has become strongly established, it is very necessary to keep the lawn quite short so that there will be no competition from the old-established grass round the edges of sown patches.

DRUGS IN TREATMENT OF STOMACH WORM IN CALVES.

INQUIRER, Otakiri :—

Could you inform me as to the relative merits of carbon tetrachloride and tetrachlorethylene for combating stomach worm in calves. I have used both the above in treating calves, and have also used bluestone solution and a mixture of kerol and raw linseed oil. All of the remedies mentioned have been more or less successful, but I have been told that the first two are rather dangerous.

The Live-stock Division :—

In comparing the efficacy of the drugs mentioned by you in the treatment of intestinal parasites of calves it cannot be claimed that any one drug possesses marked superiority over the others for the purpose indicated, and good results are obtained by the use of any one of them. It can, however, be stated that carbon tetrachloride is dangerous, as at times, and under certain conditions, the use of this drug gives rise to mortality. It is advisable, therefore, when using carbon tetrachloride first to try it on a few animals before dosing a large number. Tetrachlorethylene is said to be comparatively safer than carbon tetrachloride. In so far as the stomach worm is concerned, bluestone solution has been found to be quite as effective as the above-mentioned drugs, and whatever superiority is claimed for the latter refers to the treatment of parasites in the intestines. The most important factor in successfully dealing with this trouble in calves is the provision of extra nourishment to the calves by means of a little concentrate feeding. In this respect probably nothing can equal the giving of crushed oats and good hay. Without the adoption of extra nourishment by way of feed, it is questionable whether any medicine will prove entirely effective. Attention must also be paid to the provision of clean, fresh pasture for calves, avoiding, if possible, grazing them on paddocks which might be suspected of being previously contaminated by affected animals.